

# Evita 4

## Intensive Care Ventilator

Operating Instructions  
Software 4.n





## NOTICE

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Working with these Operating Instructions

Header line – the title...  
of the main chapter

Titles of the respective sub-sections are printed below the main header – to help you find your way quickly from subject to subject.

Page body...  
the Operating Instructions

combine text and illustrations. The information is presented as sequential steps of action, giving the user hands-on experience in learning how to use the ventilator.

Left-hand column – the text...

provides explanations and instructs the operator step-by-step in the practical use of the product, with short, clear instructions in easy-to-follow sequence. Bullet points indicate separate actions. Where several actions are described, numbers are used both to refer to the relevant details in the illustrations and to specify the sequence of actions.

Right-hand column – the illustrations...

provide visual reference for the text and for locating the various parts of the equipment. Elements mentioned in the text are highlighted. Unnecessary details are omitted. Rendering of screen displays guide the user and allow to reconfirm actions performed.

Typing conventions...

Controls are designated as »Control Name« , e.g:

»PEEP«

Screen pages are indicated as »Screen page«, e.g.

»Measured values«

Screen messages are printed in bold, e.g:

Flow Calibration

Screen messages rendered throughout the text are shown without the exclamation marks indicating their alarm level.

**NOTE:** If you wish to read these instructions without the ventilator in front of you, you may keep the full page photograph folded out.

Operation  
Calibrating

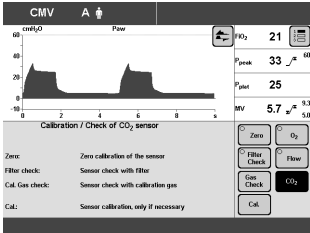
Calibrating the CO2 Sensor

The CO2 sensor must be calibrated:

- if the specified calibration values are not met when checking calibration with filter or calibration gas.
- as part of the six month preventive maintenance inspection of Evita 4.

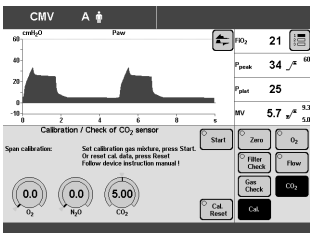
- Switch on Evita 4. Wait about 3 minutes for the CO2 sensor to complete its warm-up.
- Press »Calibration« key.

Display (example):



- Touch »CO2« screen key.

Display (example):



After the CO2 zero calibration:

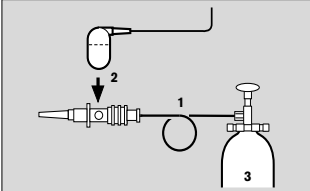
- Touch »Cal.« screen key.

- Connect calibration gas supply.  
Use cuvette from the calibration set!

- 1 Connect calibration gas cylinder and cuvette calibration to the hose.
- 2 Remove CO2 sensor from its park bracket and mount it on the calibration cuvette set.

- Read CO2, O2 and N2O concentrations (Vol.%) of calibration gas from test cylinder.

- 3 Calibration gas e.g.:  
5 Vol.% CO2  
95 Vol.% N2



WARNING !

Strictly follow this Operator's Instruction Manual

Any use of the product requires full understanding and strict observation of all portions of these instructions. The equipment is only to be used for the purpose specified under "Intended Medical Applications" (see page 24) and in conjunction with appropriate airway monitoring (see page 25). Observe all WARNINGS and CAUTIONS as rendered throughout this manual and on labels on the equipment.

Operating Instructions Evita 4, SW 4.n

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## At a Glance – New Features of Evita 4 Software 4.n

### Entering the humidifier type used

- »Heated (active) humidifier«  
or
- »HME/filter« (artificial nose)  
for a more accurate measurement of volume parameters

### Apnea ventilation On/Off

- now selectable as a startup configuration

### Extended range for alarm delay time »T<sub>Apnea</sub> $\sqrt{r}$ «

- now adjustable in the range of 5 to 60 seconds  
(was 15 to 60 seconds)

Breath rate adjustable down to 0

- for smooth weaning in PCV+ (BIPAP) and SIMV

### Ventilation mode PCV+Assist (BIPAP<sub>Assist</sub>)

- for pressure controlled, assisted ventilation

### Choice of patient mode »prev. patient«

- for using previously configured settings in effect  
before ventilator was switched off

### Leak compensation On/Off

- for switching automatic leak compensation on or off

### Extended log entries

- Evita 4, SW 4.n now marks alarms that were active  
but  
were not displayed, with a star (\*) in the log.

### Monitoring of obstructed tube

- with new warning message  
**Airway obstruction? !!!**

### Additional weaning parameter

available as SW 4.n plus upgrade

In addition to the parameter occlusion pressure P 0.1,  
Evita determines the parameters

- RSB Rapid Shallow Breathing Index  
and
- NIF Negative Inspiratory Force Index

### External flow source

available as SW 4.n plus upgrade

- Evita 4, SW 4.n determines the contribution of  
external flow and adjusts volume monitoring  
thresholds to avoid nuisance alarms.

### Extended use of loop display

available as SW 4.n plus upgrade

- loops may now be enlarged (zoomed) and frozen
- loops may now be permanently displayed in the  
upper portion of the screen

### Evita Remote (Remote Pad)

available as an option

- remote control for parallel use of Evita 4 function  
keys

### Nurse call

available as an option

- Connection for transmitting alarm signals to a central  
hospital alarm station

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## Important Safety Information

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## **Operator's Responsibility for Patient Safety**

**For correct and effective use of the product and in order to avoid hazards, it is mandatory to carefully read and to observe all portions of this manual.**

The design of the equipment, the accompanying literature, and the labeling on the equipment take into consideration that the purchase and use of the equipment are restricted to trained professionals, and that certain inherent characteristics of the equipment are known to the trained operator. Instructions, warnings, and caution statements are limited, therefore, largely to the specifics of the Dräger design. This publication excludes references to various hazards which are obvious to a medical professional and operator of this equipment, to the consequences of product misuse, and to potentially adverse effects in patients with abnormal conditions. Product modification or misuse can be dangerous. Draeger Medical, Inc. disclaims all liability for the consequences of product alterations or modifications, as well as for the consequences which might result from the combination of this product with other products whether supplied by Dräger or by other manufacturers if such a combination is not endorsed by Draeger Medical, Inc.

The operators of the ventilator system must recognize their responsibility for choosing appropriate safety monitoring that supplies adequate information on equipment performance and patient condition. Patient safety may be achieved through a wide variety of different means ranging from electronic surveillance of equipment performance and patient condition to simple, direct observation of clinical signs. The responsibility for the selection of the best level of patient monitoring lies solely with the equipment operator. (See also page 25, "Mandatory Ventilation Monitoring").

## **Limitation of Liability**

Draeger Medical, Inc.'s liability, whether arising out of or related to manufacture and sale of the goods, their installation, demonstration, sales representation, use, performance, or otherwise, including any liability based upon Draeger Medical, Inc.'s Product Warranty, is subject to and limited to the exclusive terms and conditions as set forth, whether based upon breach of warranty or any other cause of action whatsoever, regardless of any fault attributable to Draeger Medical, Inc. and regardless of the form of action (including, without limitation, breach of warranty, negligence, strict liability, or otherwise).

THE STATED EXPRESSED WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR NONINFRINGEMENT.

Draeger Medical, Inc. shall not be liable for, nor shall buyer be entitled to recover any special incidental, or consequential damages or for any liability incurred by buyer to any third party in any way arising out of or relating to the goods.

## Warranty

All Dräger products are guaranteed to be free of defects for a period of one year from date of delivery. The following are exceptions to this warranty:

1. The defect shall be a result of workmanship or material. Defects caused by misuse, mishandling, tampering, or by modifications not authorized by Draeger Medical, Inc. or its representatives are not covered.
2. Rubber and plastic components and materials are warranted to be free of defects at time of delivery.
3. Oxygen sensors capsules have a 12 month limited warranty from the date of delivery.

Any product which proves to be defective in workmanship or material will be replaced, credited, or repaired with Draeger Medical, Inc. holding the option. Draeger Medical, Inc. is not responsible for deterioration, wear, or abuse. In any case, Draeger Medical, Inc. will not be liable beyond the original selling price.

Application of this warranty is subject to the following conditions:

1. Draeger Medical, Inc. or its authorized representative must be promptly notified, in writing, upon detection of the defective material or equipment.
2. Defective material or equipment must be returned, shipping prepaid, to Dräger or its authorized representative.
3. Examination by Draeger Medical, Inc. or its authorized representative must confirm that the defect is covered by the terms of this warranty.
4. Notification in writing of defective material or equipment must be received by Draeger Medical, Inc. or its authorized representative no later than two (2) weeks following expiration of this warranty.

The above is the sole warranty provided by Draeger Medical, Inc. No other warranty expressed or implied is intended. Representatives of Dräger are not authorized to modify the terms of this warranty.

Draeger Medical, Inc., Telford, PA

## Definitions

### WARNING !

A **WARNING** statement refers to conditions with a possibility of personal injury if disregarded.

### CAUTION !

A **CAUTION** statement designates the possibility of damage to equipment if disregarded.

**NOTE:** A **NOTE** provides additional information intended to avoid inconveniences during operation.

<b>Inspection</b>	= examination of actual condition
<b>Service</b>	= measures to maintain specified condition
<b>Repair</b>	= measures to restore specified condition
<b>Maintenance</b>	= inspection, service, and repair, where necessary
<b>Preventive Maintenance</b>	= Maintenance measures at regular intervals

### Typing conventions in this manual

Controls (dedicated function keys and screen keys / knobs) are designated as »**Control Name**«, e.g.

»**Configuration**«

Screen pages are indicated as »Screen page«, e.g.

»Measured values«

On-screen messages are printed in **bold**, e.g.

### Flow Calibration

Screen messages rendered throughout the text are shown without the exclamation marks indicating their alarm level.

## Summary of WARNINGS and CAUTIONS

### WARNING !

Strictly follow this Operator's Instruction Manual

Any use of the product requires full understanding and strict observation of all portions of these instructions. The equipment is only to be used for the purpose specified under "Intended Medical Applications" (see page 24) and in conjunction with appropriate airway monitoring (see page 25). Observe all **WARNINGS** and **CAUTIONS** as rendered throughout this manual and on labels on the equipment.

### WARNING !

The Evita 4 ventilator must only be used under the supervision of qualified medical personnel in order to provide immediate corrective action in case of a malfunction

### WARNING !

**DANGER**, risk of explosion if used in the presence of flammable anesthetics.

This device is neither approved nor certified for use in areas where combustible or explosive gas mixtures with air or with nitrous oxide are likely.

### WARNING !

Do not use wireless or cellular phones within 33 feet (10 m) of the equipment.

Radio communication devices may cause malfunction in electromedical equipment.

### WARNING !

Whenever a patient is connected to the ventilator, constant attention by qualified medical staff is required in order to provide immediate corrective action in case of a malfunction.

## Precautions During Preparation

### **WARNING !**

In case of malfunction of any of the built-in monitoring, a substitute is recommended in order to maintain an adequate level of monitoring. The operator of the ventilator must still assume full responsibility for proper ventilation and patient safety in all situations.

### **WARNING !**

Always install components that have been cleaned and disinfected according to approved hospital procedures.

### **WARNING !**

If a fault is detected in the ventilator and its life support functions are in doubt, ventilation must be started without delay with an independent ventilation device (resuscitation bag) - using PEEP and/or increased inspiratory O<sub>2</sub> concentration where necessary and appropriate. The unit should then be removed from use and serviced by DraegerService or factory trained and authorized technical service personnel.

### **WARNING !**

Treatment of batteries and O<sub>2</sub> sensor capsules:

Do not throw into fire! Risk of explosion.

Do not force open! Danger of bodily injury.

Follow all local, state, and federal regulations with respect to environmental protection when disposing of batteries and O<sub>2</sub> sensor capsules.

### **CAUTION !**

#### **Restriction of Distribution**

Federal Law and Regulations in the United States and Canada restrict this device to sale by or on the order of a physician.

### **WARNING !**

Dräger cannot warrant or endorse the safe performance of heat/moisture exchangers.

The user must verify that the heat/moisture exchanger is covered by a technical safety certificate which guarantees complete suitability for the intended use.

Do not use a heat/moisture exchanger simultaneously with a nebulizer or heated humidifier!

Risk of increased breathing resistance due to condensation.

### **WARNING !**

The flow resistance of bacteria filters placed in the expiratory side may be substantially increased by nebulized aerosols with the risk of impaired ventilation. If an expiratory filter is used during nebulization, airway pressures and flow should be monitored for any indication of increased expiratory resistance due to filter obstruction.

### **WARNING !**

Dräger cannot warrant or endorse the safe performance of third party humidifiers that are not described in this manual for use with the Evita 4 ventilator. Specifically, the user must assess the risks of delivery of breathing gas not maintained at a proper temperature associated with different humidifier designs. We strongly recommend using the electronic temperature monitoring feature of the ventilator if no proximal airway temperature monitoring is performed by the humidifier used.

Increased pneumatic resistance in the inspiratory line caused by a humidifier may result in less accurate airway pressure readings.

We recommend contacting the manufacturers/distributors of third party humidifier devices about compliance of their products with the requested performance characteristics.

### **WARNING !**

Do not use a heat/moisture exchanger simultaneously with a nebulizer or heated humidifier!

Risk of increased breathing resistance due to condensation.

### **WARNING !**

To avoid any risk of electric shock in the event of faulty grounding of patient monitoring equipment, do not use antistatic or electrically conductive patient circuits.

### **WARNING !**

It is strongly recommended using the electronic temperature monitoring feature of the ventilator if no proximal airway temperature monitoring is performed by the humidifier used.

### **WARNING !**

To maintain grounding integrity, connect only to a "hospital grade" receptacle. Always disconnect supply before servicing.

### **WARNING !**

Connecting other devices to the same extension power strip may cause the leakage current to the patient to increase beyond the permissible values in the event of grounding failure.

In this case, the risk of electric shock cannot be safely excluded.

### **WARNING !**

Installation and activation of the EvitaRemote kit should only be performed by DraegerService or factory trained and authorized service personnel.

### **WARNING !**

Installation of the Evita nurse call kit should only be performed by DraegerService or factory trained and authorized service personnel.

### **WARNING !**

The operator of the ventilator must still assume full responsibility for ventilation monitoring via the Evita 4 screen when the nurse call is connected.

Only highest priority alarms (!!!) will activate the nurse call.

- Check screen displays frequently.

### **WARNING !**

Always use medical grade oxygen and air that is dry and free from dust and oil. Contaminated gas may cause ventilator malfunction.

### **WARNING !**

The ventilator is ready for operation only when:

- it is completely assembled with all required auxiliary equipment in place,
- all sensors are calibrated (O<sub>2</sub>, Flow, CO<sub>2</sub>)
- the »device check« has been completed successfully.

## Precautions During Operation

### CAUTION !

Do not place containers of liquids on top of the Evita 4 ventilator. Liquids penetrating the ventilator can cause equipment malfunction and damage.

### WARNING !

Always use ventilator that has been cleaned and disinfected and has been successfully tested to be ready for operation.

### CAUTION !

To prevent accidental blockage of air intake, protective cover must always be in place for operation.

### WARNING !

In case of malfunction of any of the built-in monitoring, a substitute must be provided to maintain an adequate level of monitoring. The operator of the ventilator must still assume full responsibility for proper ventilation and patient safety in all situations.

### CAUTION !

Do not drop control panel - physical damage to the unit is likely.

Do not allow control panel to lean against any objects in an upright position.

When changing panel, lay it on its back.

### WARNING !

If a fault is detected in the ventilator and its life support functions are in doubt, ventilation must be started without delay with an independent ventilation device (resuscitation bag) - using PEEP and/or increased inspiratory O<sub>2</sub> concentration where necessary and appropriate. The unit should then be removed from use and serviced by factory trained and authorized service personnel.

### WARNING !

- Always use extreme caution when using oxygen!
- Oxygen intensely supports any burning! No smoking, no open fire in areas where oxygen is in use!
- Always provide adequate ventilation in order to maintain ambient O<sub>2</sub> concentrations < 24 %.
- Always secure O<sub>2</sub> cylinders against tipping, do not expose to extreme heat.
- Do not use oil or grease on O<sub>2</sub> equipment such as tank valves or pressure regulators. Do not touch with oily hands. Risk of fire!
- Open and close valves slowly, with smooth turns. Do not use any tools.

**WARNING !**

Always heed all precautions and follow all hospital protocols with respect to the administration of oxygen. Make adjustments to the FiO<sub>2</sub> according to the blood gas values measured.

**WARNING !**

Do not block air intake. Ventilator malfunction will result.

**WARNING !**

Warning or Caution level audible alarms require immediate operator attention to avert or to prevent development of situations with the possibility of patient injury.

**WARNING !**

The alarm silence key is intended to provide a way of muting audible alarms while corrective action is taken. The operator of the ventilator must still assume responsibility for proper ventilation and patient safety in the event of an alarm. Failure to identify and correct alarm situations may result in patient injury.

**WARNING !**

The integrated nebulizer function of Evita 4 is designed for nebulizers with a nebulizing flow of 6 L/min at 29 psi (2 bar), for example nebulizer 84 12 935 (white central body). Other nebulizers may cause deviations in tidal volume and inspiratory O<sub>2</sub> concentration!

**WARNING !**

For breath rates below 12 bpm, deviations from set oxygen concentration can be significantly higher in extreme cases.

These deviations cannot be monitored by the internal O<sub>2</sub> analyzer of the ventilator.

**WARNING !**

Consider effects of aerosols on sensors, filters, and heat and moisture exchangers (HMEs)!

The measuring function of the flow sensor may be impaired.

The flow resistance of filters is liable to increase and may impair ventilation.

Do not put a microbial filter on the nebulizer outlet when in use!

**WARNING !**

Do not use a heat/moisture exchanger simultaneously with a nebulizer or heated humidifier!

Risk of increased breathing resistance due to condensation.

**WARNING !**

In case of malfunction of any of the built-in monitoring, a substitute must be provided in order to maintain an adequate level of monitoring. The operator of the ventilator must still assume full responsibility for proper ventilation and patient safety in all situations.

**WARNING !**

The hot wire in the flow sensors is heated well above its normal operating temperature during the cleaning process. Therefore, avoid flammable gases (e.g. ethanol vapors after disinfection).

Vent flow sensors after disinfection with ethanol for at least 30 minutes.

**CAUTION !**

Do not place containers of liquids on top of the Evita 4 ventilator. Liquids penetrating the ventilator can cause equipment malfunction and damage.



## Precautions During Configuration

### **WARNING !**

Configuration of ventilation modes and default parameters should only be performed by staff authorized by a hospital protocol.

### **WARNING !**

Diagnostic procedures on the Evita 4 ventilator should be performed by factory trained and authorized service personnel only.

## Precautions During Care

### **WARNING !**

Always follow accepted hospital procedures for handling equipment contaminated with body fluids.

### **WARNING !**

Allow flow sensor to air for at least 30 minutes after bath disinfection in alcohol. Otherwise, residual alcohol vapor and increased heat energy during calibration could result in combustion and destroy sensor.

### **WARNING !**

Follow all accepted hospital procedures for disinfecting parts contaminated by body fluids (protective clothing, eyewear, etc.).

### **CAUTION !**

The temperature sensor is not designed for disinfection in an automatic parts washer or for bath disinfection.

### **CAUTION !**

The flow sensor is not autoclavable and is not designed for disinfection in an automatic parts washer.

### **CAUTION !**

Do not disassemble expiratory valve beyond removing diaphragm!

### **CAUTION !**

Certain components of the ventilator consist of materials that are sensitive to certain organic solvents sometimes used for cleaning and disinfecting (e.g., phenols, halogen releasing compounds, oxygen releasing compounds, strong organic acids, etc.). Exposure to such substances may cause damage that is not always immediately recognized. Sterilization with ethylene oxide (EtO) is also not recommended.

**CAUTION !**

The screen of the ventilator control panel is made of Plexiglas® (polyacrylate). Do not clean or disinfect with agents containing alcohol as this might cause stress cracks in the material.

**CAUTION !**

Make certain that no liquid remains in the pressure measuring canal of the expiratory valve, as it might cause malfunction.

**Precautions During Maintenance**

**WARNING !**

To avoid any risk of infection, clean and disinfect ventilator and accessories before any maintenance according to established hospital procedures - this applies also when returning ventilators or parts for repair.

**WARNING !**

Preventive Maintenance work on the Evita 4 ventilator shall be performed by factory trained and authorized service personnel only.

**WARNING !**

Never operate the ventilator if it has suffered physical damage or does not seem to operate properly. In this case always refer servicing to properly trained and factory authorized service personnel.

**WARNING !**

**Treatment of batteries and O<sub>2</sub> sensor capsules:**

**Do not throw into fire! Risk of explosion.**

**Do not force open! Danger of bodily injury.**

**Follow all local, state, and federal regulations with respect to environmental protection when disposing of batteries and O<sub>2</sub> sensor capsules.**

**CAUTION !**

**Maintenance**

In case of malfunction of this component, contact your local DraegerService or our Factory Authorized Technical Service Center.

The devices must be inspected and serviced (preventive maintenance) by factory trained and authorized technical service representatives at regular 6 month intervals. A record must be kept on this preventive maintenance. We recommend obtaining a service contract through your vendor.

Maintenance or repair of Evita ventilators shall be performed only by Dräger authorized technical service representatives.

**Theory of Operation**

**WARNING !**

Always set the alarm limit »Paw  $\nearrow$ « in order to generate an alarm in the event of an increase in airway pressure with reduced compliance.

**WARNING !**

Always set alarm limits MV  $\searrow$  and MV  $\nearrow$  to avoid over- or under-ventilating a patient with a rapidly changing compliance.

**Intended Use**

**Contents**

**Intended Medical Applications.....24**  
**Ventilation Modes..... 24**  
**Mandatory Ventilation Monitoring..... 25**  
Back-Up Ventilation With an Independent Manual Ventilation Device..... 25

## Intended Medical Application

Evita 4 is a time cycled, constant volume, long term, intensive care ventilator for adults and children with a body weight of at least 3 kg.

### WARNING !

To maintain grounding integrity, connect only to a "hospital grade" receptacle. Always disconnect supply before servicing.

### WARNING !

**DANGER**, risk of explosion if used in the presence of flammable anesthetics.

This device is neither approved nor certified for use in areas where combustible or explosive gas mixtures with air or with nitrous oxide are likely.

### WARNING !

Do not use wireless or cellular phones within 33 feet (10 m) of the equipment.

Radio communication devices may cause malfunction in electromedical equipment.

### WARNING !

Whenever a patient is connected to the ventilator, constant attention by qualified medical staff is required in order to provide immediate corrective action in case of a malfunction.

## Ventilation Modes

Evita 4 features the following ventilation modes:

### **CMV** (Continuous Mandatory Ventilation)

controlled and assisted constant volume ventilation.

With the options:

- **CPPV** (Continuous Positive Pressure Ventilation)
- **PLV** (Pressure Limited Ventilation)
- **AutoFlow®\***  
automatically optimizing inspiratory flow
- **IRV** (Inversed Ratio Ventilation).

### **SIMV** (Synchronized Intermittent Mandatory Ventilation)

procedure for weaning patients off the ventilator after they have started spontaneous breathing.

With the options:

- **PLV** (Pressure Limited Ventilation)
- **AutoFlow®\***  
automatically optimizing inspiratory flow.

### **MMV** (Mandatory Minute Volume Ventilation)

spontaneous breathing with automatic adjustment of mandatory ventilation to the patient's minute volume requirement.

With the options:

- **PLV** (Pressure Limited Ventilation)
- **AutoFlow®\***  
automatically optimizing inspiratory flow.

### **CPAP** (Continuous Positive Airway Pressure)

Spontaneous breathing with positive airway pressure.

### **PS** (Pressure Support)

Pressure supported spontaneous breathing.

### **PCV+** (Pressure Controlled Ventilation plus) (BIPAP\*\*)

Pressure controlled ventilation combined with free spontaneous breathing during the complete breathing cycle, and with adjustable pressure increase to CPAP level.

### **PCV+<sub>Assist</sub>** (Pressure Controlled Ventilation plus, Assisted) (BIPAP\*\*<sub>Assist</sub>)

Pressure controlled, assisted ventilation.

### **APRV** (Airway Pressure Release Ventilation)

Spontaneous breathing on two pressure levels with long time ranges – independently adjustable.

\* AutoFlow® is a registered trademark of Drägerwerk Aktiengesellschaft.

\*\* The registered trademark BIPAP is used under license.

Special modes:

### **Apnea Ventilation**

For automatically switching over to volume controlled mandatory ventilation, if spontaneous breathing stops. If apnea occurs, Evita 4 sounds an alarm after the preset alarm period ( $T_{\text{apnea}} \sqrt{\text{r}}$ ) and starts volume controlled ventilation.

### **ILV (Independent Lung Ventilation)**

Separate, differential, synchronized ventilation with one Evita ventilator for each lung.

Evita 4 features the following diagnostic maneuvers:

### **Intrinsic PEEP measurement**

for determining intrinsic PEEP and measuring trapped volume.

### **Occlusion pressure measurement**

for evaluating a patient's breathing drive during spontaneous breathing.

Other features include:

### **Automatic gas switchover**

In the event of a failure of one of the supply gases, the switchover to the other gas is automatic.

## **Mandatory Ventilation Monitoring**

Respiratory monitoring integrated into the Evita 4 ventilator is intended to adequately monitor ventilation and to recognize undesirable changes in the respiratory parameters:

- airway pressure,  $P_{\text{aw}}$
- expiratory minute volume, MV
- inspiratory O<sub>2</sub> concentration,  $\text{FiO}_2$
- inspiratory breathing gas temperature, T
- expiratory CO<sub>2</sub> concentration,  $\text{etCO}_2$
- inspiratory breathing volume, VT<sub>I</sub>
- apnea time
- breathing rate (tachypnea monitoring)

Changes in these parameters may be caused by:

- acute changes in the patient's condition
- incorrect settings and improper handling
- equipment malfunctions
- failure of power and gas supplies

In case of a fault in the integrated monitoring equipment, independent measuring instruments (such as a patient monitor, oxygen analyzer, breathing gas temperature monitor, etc.) must be used.

### **WARNING !**

**In case of malfunction of any of the built-in monitoring, a substitute is recommended in order to maintain an adequate level of monitoring. The operator of the ventilator must still assume full responsibility for proper ventilation and patient safety in all situations.**

## **Back-Up Ventilation With an Independent Manual Ventilation Device (Resuscitation Bag)**

### **WARNING !**

**If a fault is detected in the ventilator and its life support functions are in doubt, ventilation must be started without delay with an independent ventilation device (resuscitation bag) - using PEEP and/or increased inspiratory O<sub>2</sub> concentration where necessary and appropriate. The unit should then be removed from use and serviced by DraegerService or factory trained and authorized technical service personnel.**

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## Operating Concept

### Contents

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## Control Panel Layout

The main components of the control panel are the screen, a set of **preconfigured function keys** ("hard" keys), and the **central rotary dial knob**.

The function keys are used to call up **screen pages** relevant to a particular operation.

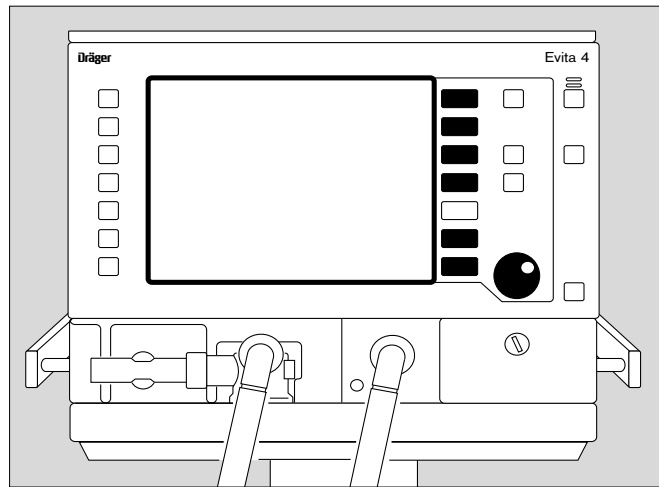
In addition to waveforms, measured values, and status displays, the screen displays touch-sensitive keys and knobs for parameter setting in a separate field.

These touch-sensitive **screen keys** and the **screen knobs** are used in a manner similar to ordinary keys and knobs:

Touching a control element with the fingertip is equivalent to pressing a key or taking hold of a knob.

Only screen keys and screen knobs that are required for function selection and/or adjustment in a particular situation are included in the respective screen display.

Settings and confirmations are made by turning and pressing the dial knob.

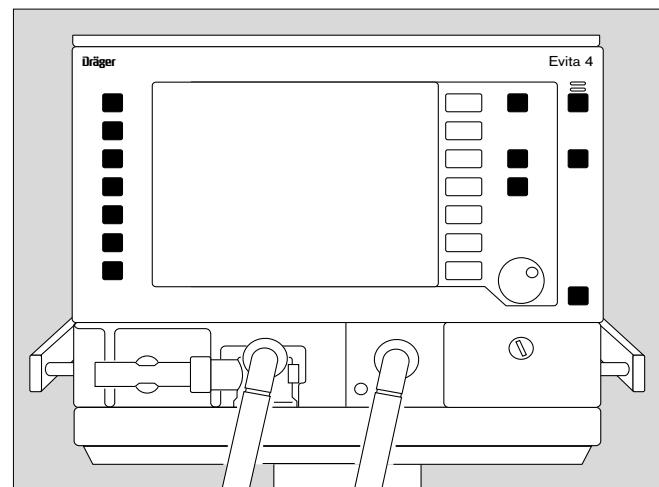


Dedicated (hard) function keys for routine functions are placed on the right and left side of the screen on the control panel.

Frequently used function keys are placed to the right, e.g. the **»Main Screen«** key for selecting the standard page,

or

the **»Alarm Reset«** key for resetting or confirming messages.



Less frequently used function keys are placed on the left-hand side of the control panel,

e.g.

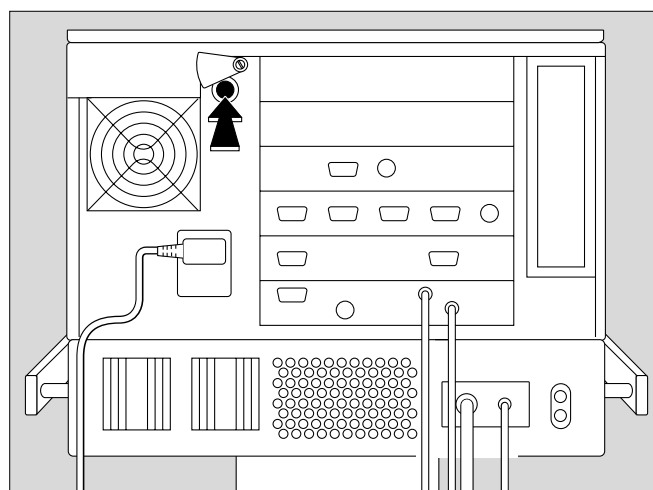
the **»Neb.«** key for switching the nebulizer on/off,

or the **»O<sub>2</sub> Suction«** key for the oxygenation program during bronchial suction.



### The power switch

For switching the ventilator on and off.  
The power switch is located at the rear of the ventilator and has a pivoting cover to protect against inadvertently switching off the ventilator.



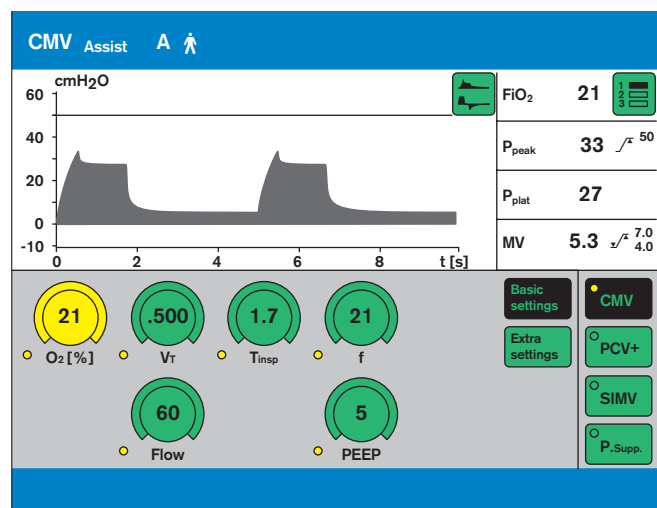
## On-Screen Controls

The lower half of the screen contains touch sensitive colored **screen keys** and **screen knobs**.

Touching these controls with the fingertip is equivalent to pressing a key or taking hold of a knob.

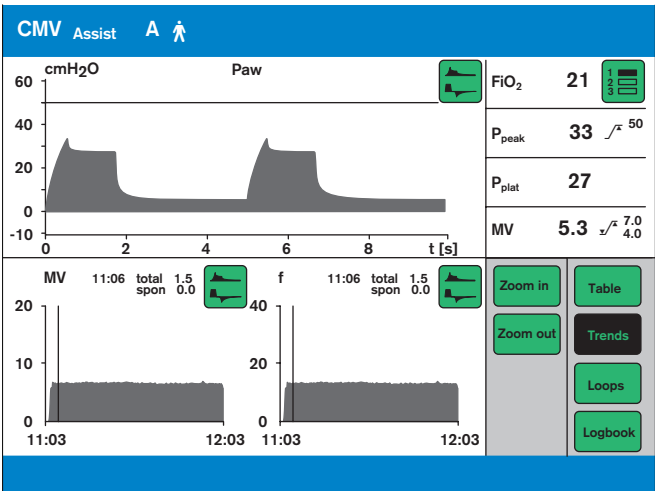
The color indicates the status of the "control" and the "LEDs":

- green = applicable
- white = not applicable
- yellow = ready to adjust/confirm
- black = function/display in effect



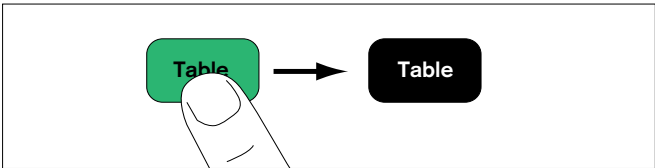
Screen Keys for Selecting Functions Without Confirmation

e.g. for paging through the system on-screen,  
for changing to a different menu,  
for switching between displays.



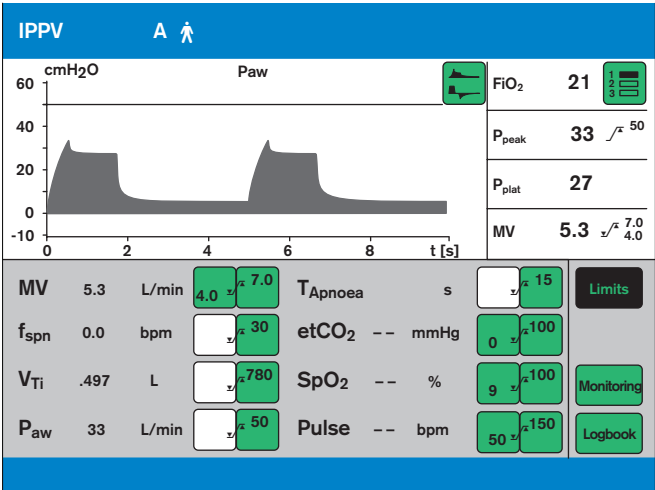
example:

- Press »Table« key to select display of data tables.  
The key turns black indicating that this selection is now active.



Screen Keys for Selecting and Adjusting With Confirmation

Display (example):



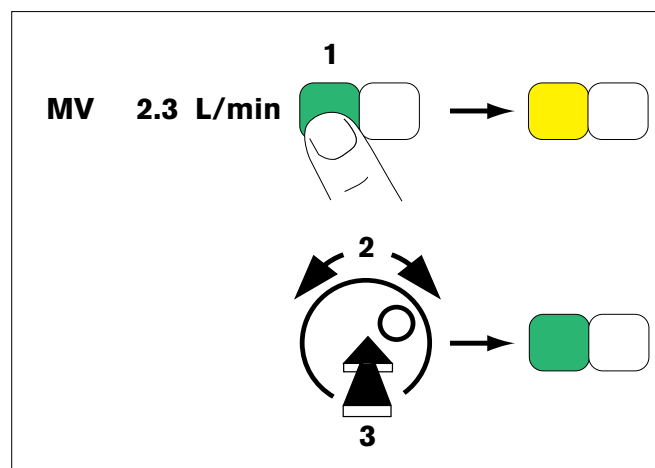
- 1 Touch the screen key for the respective alarm limit, e.g.:

**MV 2.3 L/min**



The color changes from green to yellow indicating that the ventilator is ready for setting.

- 2 Turn dial knob to adjust the alarm limit. The value is displayed in the screen key.
- 3 Press dial knob and the color changes from yellow back to green indicating that the alarm limit set is now confirmed and in effect.



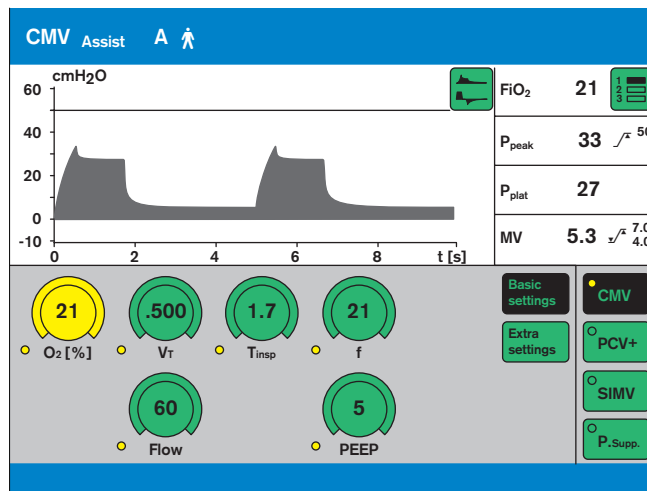
To cancel a setting:

Before confirming the setting

- Touch the screen key again
- or
- touch another screen key.

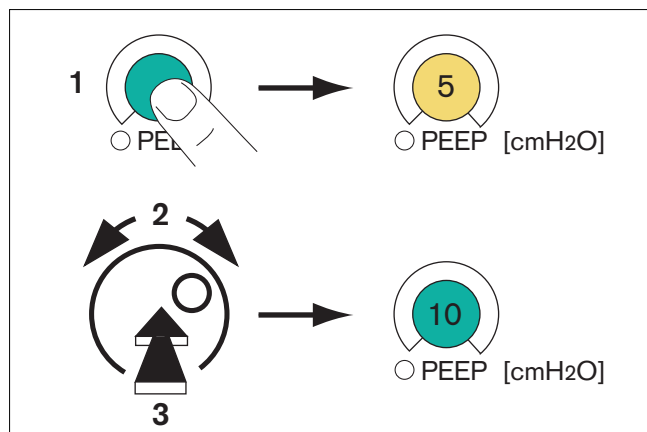
## Screen Knobs for Setting Parameters

Display (example):



e.g. »PEEP« screen knob.

- 1 Touch the »PEEP« screen knob:  
It changes color from green to yellow indicating that the ventilator is ready for setting.
- 2 Turn dial knob to adjust setting.  
The value is displayed in the screen knob.
- 3 Press dial knob to confirm.  
The screen knob changes color from yellow back to green indicating that the setting is validated and has taken effect.



While making adjustments, pressure values such as  $P_{\text{max}}$  are inserted into the  $P_{\text{aw}}(t)$  waveform display as dashed lines.




To cancel the setting:

- Press the screen knob again,  
or
- press another screen knob.

## Screen Pages

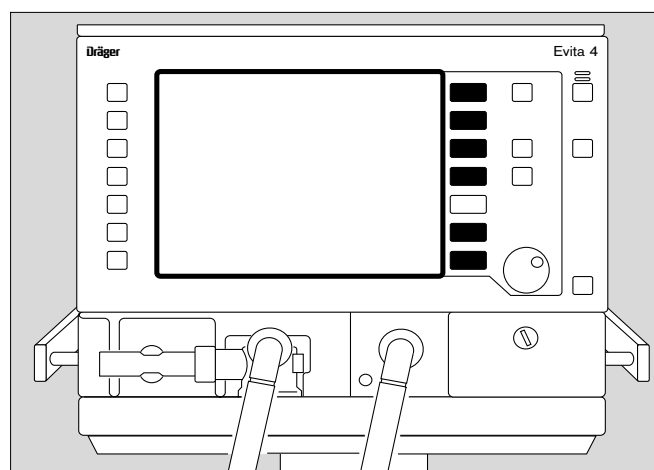
All screen pages follow the same structure, i.e. their content is always arranged in the same layout on screen:

For easy orientation and operating of the ventilator, messages indicating ventilation modes and alarms, displays of measured values and waveforms, and help functions, always appear in the same position on screen:

- ① The **current ventilation mode/patient mode** is displayed on the left-hand side of the top field. Ventilation modes are indicated with their abbreviation, e.g. PCV<sup>+</sup>.  
  
The patient mode is indicated by symbols:  
A  for adult mode  
P  for pediatric mode
- ② **Waveforms** are displayed in the upper left-hand section of the screen.
- ③ The lower half of the screen may show waveforms and measured values or **screen keys** and **screen knobs** – depending on the screen page selected.
- ④ **Alarms** are displayed in the top right corner.
- ⑤ **Measured values** are displayed in the upper right-hand section of the screen.
- ⑥ **Help functions** appear in the bottom line of the screen. On the right, Evita 4 provides setting instructions. On the left, there is information on the current status – pressing the »  « function key calls this information up on screen.

The function keys along the right of the screen are used to select screen pages specific to the following operations:

- **Mode settings**
- **Alarm limits**
- **Values measured**
- **Special procedure (measurement maneuvers)**
- **Calibration**
- **Configuration**



## Standard Page

For displaying ventilation status:

- Press »Main Screen« key.

Display (example):

The standard page shows the ventilation status at a glance – reduced to the most important measured parameters and waveforms.


Four measured values are shown on the right, and two waveforms on the left.

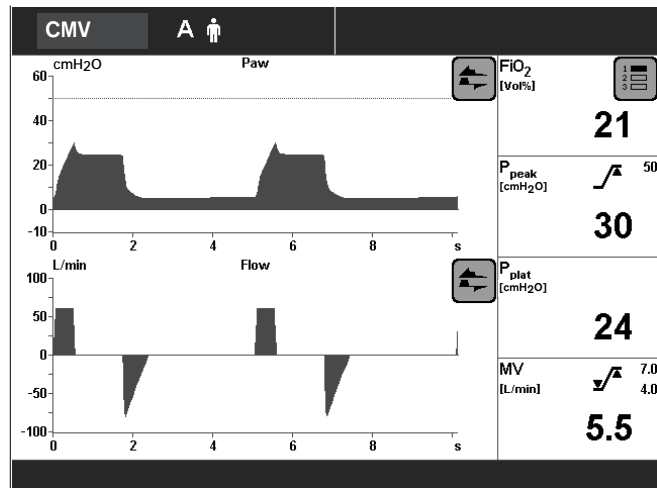
Other measured values and waveforms can be selected in the standard page and all subsequently shown screen pages.

To select other measured value combinations:

- Touch screen key »« repeatedly.

To select other waveforms:

- Touch »« key, and then touch the screen key of the desired waveform.



## »Mode Settings« Screen Page

For displaying and setting parameters.

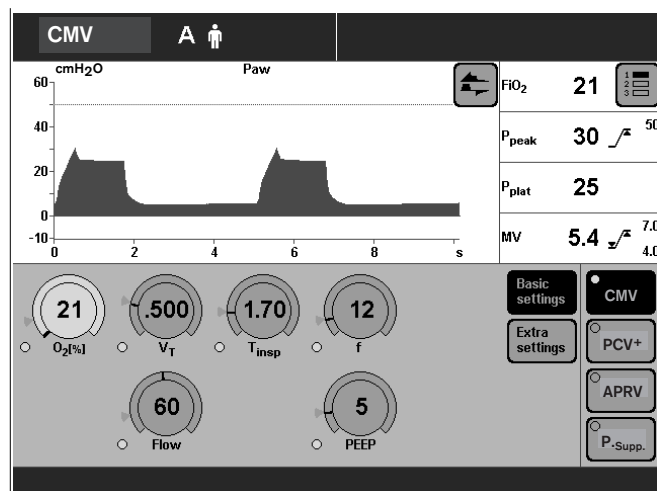
The bottom right-hand side of the screen contains the screen keys for selecting ventilation modes.

The screen key displayed in black indicates the currently active mode of ventilation (CMV in this example).

The bottom left-hand side of the screen contains the on-screen setting knobs.

Set values of parameters are displayed in the screen knobs relevant to the current ventilation mode.

Evita 4 determines recommended settings on a patient specific basis using the Radford nomogram. The recommended value is marked by an arrow (►) on the outer knob scale.



## Changing the settings of an active ventilation mode

- Touch the appropriate screen knob, which will change color from green to yellow indicating that the parameter is ready for setting.
- Turn dial knob on the control panel to adjust set value of the screen knob parameter.
- Press dial knob. The screen knob changes color from yellow back to green indicating that the setting is confirmed and active.

### Selecting another ventilation mode and setting its parameters

- Touch the respective screen key, e.g. »PCV+«. The key changes color from green to yellow, and the parameter setting page for PCV+ is displayed.

To set the parameters for PCV+ (BIPAP):

- Touch a screen knob, which changes color from green to yellow indicating it is ready for setting.
- Turn dial knob to adjust set value of the screen knob parameter.
- Press dial knob: the screen knob changes color from yellow back to green indicating that the new setting is confirmed and in effect.

**NOTE:** If the indicator "LED" next to a screen knob is not illuminated yellow, the setting for this knob will only go into effect after the new ventilation mode has been switched on (example: »PSupp.« knob).

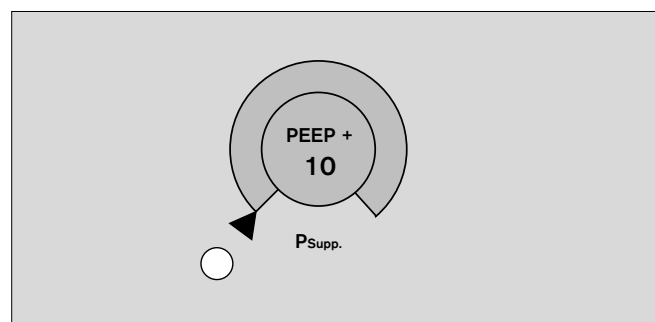
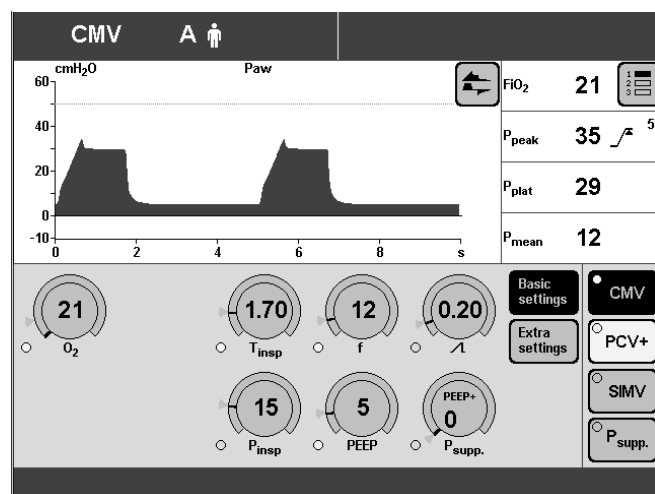
If the indicator "LED" is illuminated yellow, the respective knob setting is already active in the current ventilation mode (example: »O<sub>2</sub>« knob) and the change will therefore become effective immediately.

The startup values effective upon switching on the ventilator are marked on the respective knob scale with an arrow (►).

Example: P<sub>Supp.</sub> = 0 cmH<sub>2</sub>O

- Press the dial knob: the screen key changes color from yellow to black indicating the new ventilation mode is active.

For detailed instructions on how to set ventilation modes, please refer to page 70.



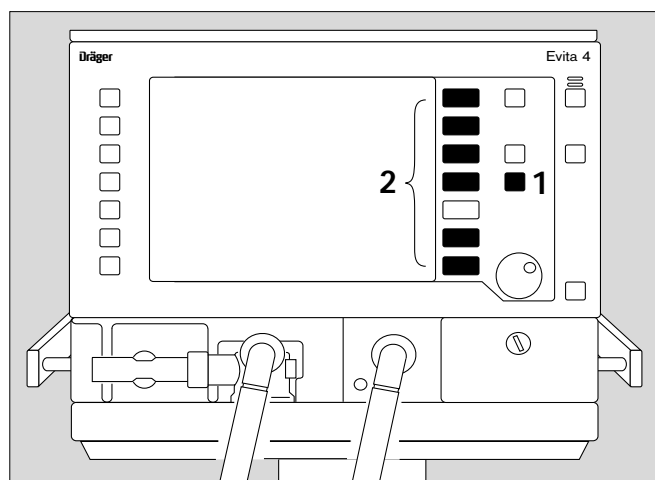
### To cancel a selection/setting

Without confirming:

- Press the screen key or screen knob again,
- or
- press another screen key or another screen knob.

To quit a screen page:

- 1 Press »Main Screen« key to return to standard page,
- or
- 2 press any of the function keys next to the screen on the right.



## »Alarm Limits« Screen Page

This page is used for:

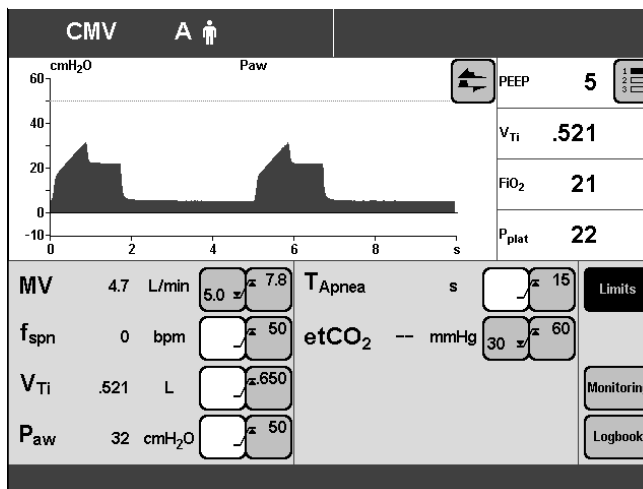
Displaying measured values and the corresponding alarm limits.

Setting alarm limits.

Adjusting monitoring functions.

Displaying the logbook.

Alarm limits are grouped together in a field on the lower left of the screen and combined with one waveform and four measured values.



Limits, monitoring, and logbook functions are selected with screen keys on the right and with the key of the currently active screen page highlighted in black.

### Displaying/setting alarm limits

- Touch the »Limits« screen key. The screen key will be highlighted in black and monitored parameters will be displayed together with their alarm limits.

Example:

MV 6.8 L/min

Left-hand screen key = lower alarm limit.  
Right-hand screen key = upper alarm limit.

To set the alarm limit:

- Touch the respective screen key.  
The key changes color to yellow indicating that the alarm limit is ready for setting.
- Turn dial knob to adjust value as displayed in the key.
- Press dial knob. The screen key changes color back to green indicating that the setting is confirmed.  
The alarm limit is now in effect.

For detailed operating instructions, please refer to page 92.



## »Values Measured« Screen Page

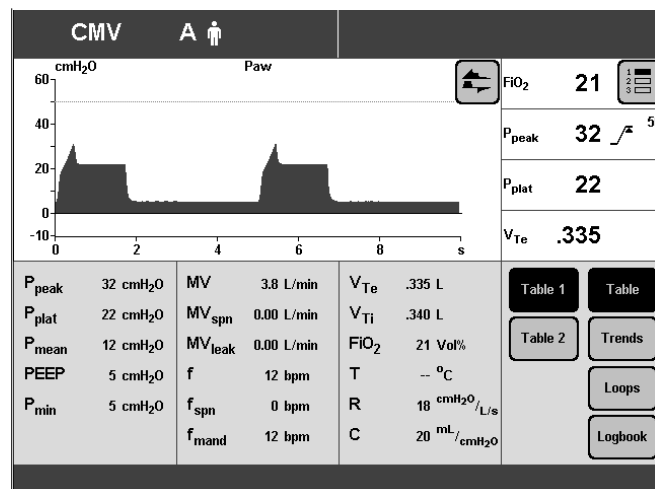
This page is used to display:

- the values measured in table format
- graphic trends
- loops
- logbook.

Tables, trends, loops, and logbook are selected with the right-hand column of screen keys.

Example: Table of measured values »Table 1«

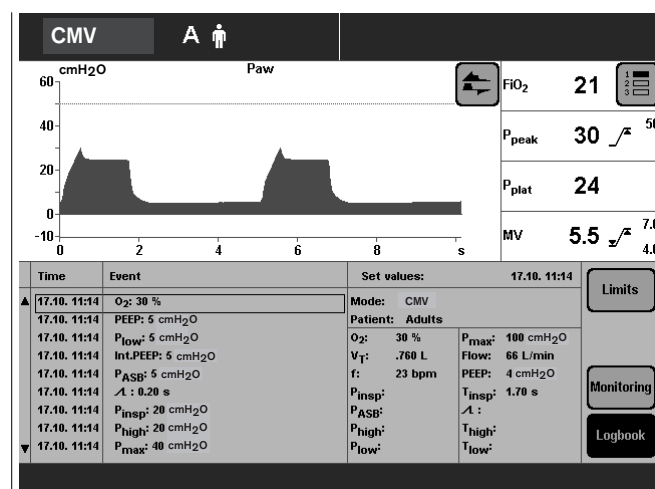
For detailed operating instructions, please refer to page 96.



## Display Logbook

- Touch the »Logbook« screen key.
- Turn dial knob to select alarm events.

For detailed operating instructions, please refer to page 100.



## »Special Procedure« Screen Page

This page is used to display and perform the following special measuring maneuvers:

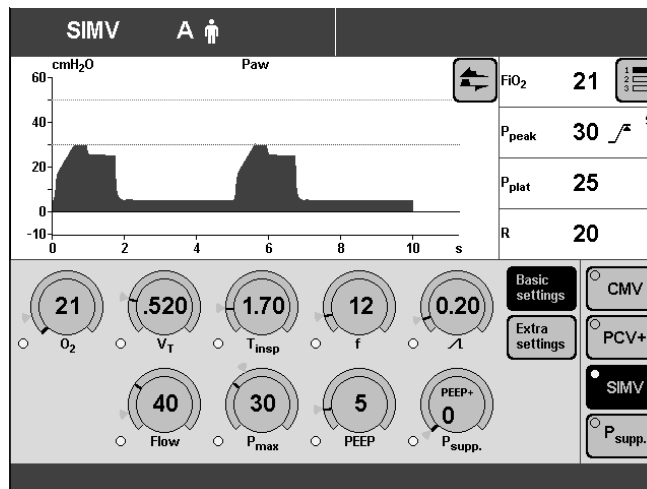
- Intrinsic PEEP
- and
- Occlusion pressure P 0.1.

The desired special procedure is selected with the respective screen key on the right. The result of the last measuring maneuver is displayed.

Example: Intrinsic PEEP:

To start the maneuver:

- Touch the **»Start«** screen key.



For detailed operating instructions, please refer to pages 107 and 108, respectively.

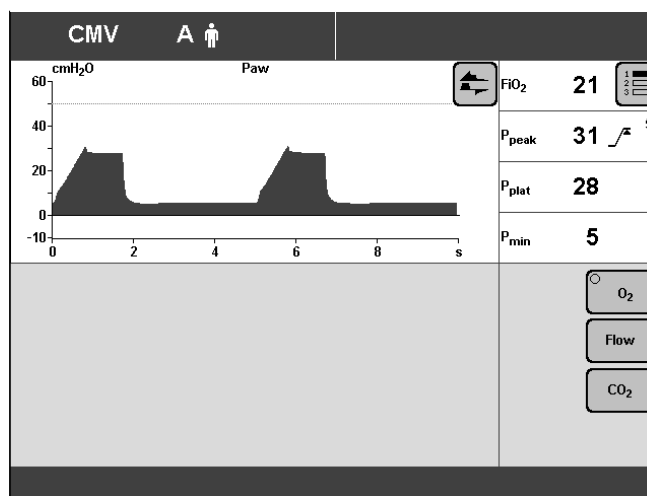
## »Calibration« Screen Page

This page is used for calibrating:

- O<sub>2</sub> sensor
- flow sensor
- CO<sub>2</sub> sensor
- Select sensor to be calibrated with the **»O<sub>2</sub>«**, **»Flow«** or **»CO<sub>2</sub>«** screen keys. Calibration starts as soon as one of these keys is pressed.

Evita 4 provides necessary calibration instructions in the help text line at the bottom of the screen.

For detailed operating instructions, please refer to page 111.



## »Configuration« Screen Page

For selecting/adjusting the following functions:

### Sound

Setting the volume of the audible alarm.

### Screen

Selecting measured values to be displayed.

Selecting waveforms to be displayed.

Selecting trends to be displayed.

### Ventilation

Selecting ventilation modes.

Selecting the patient mode.

Selecting startup settings.

### System Defaults

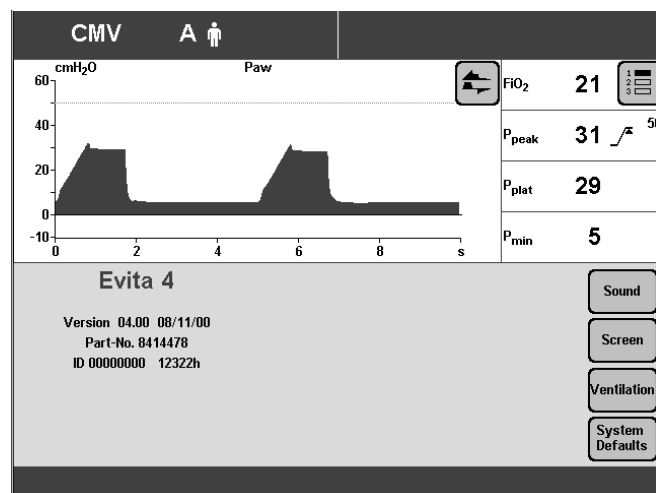
Setting the external interface.

Setting time and date.

Selecting the language and units of measurement.

Selecting service diagnostics.

For detailed operating instructions, see page 121.

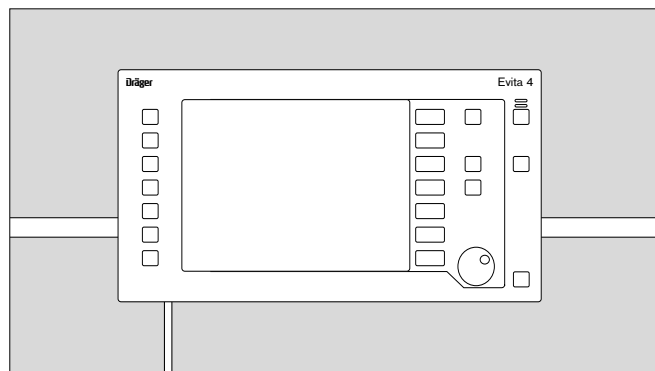


## Placing the Control Panel

To adapt the ventilator to the conditions in a particular physical location, the control panel can be placed

- either attached directly to the ventilator, or
- separately, on a wall rail.

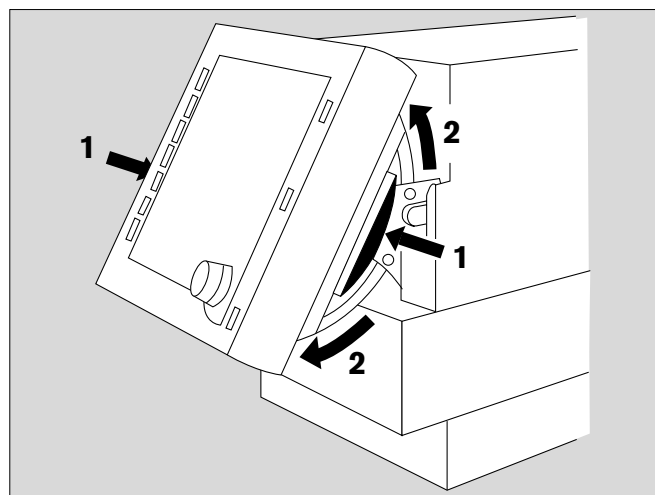
For detailed instructions on placement, see page 63.



## Ergonomic Positioning

To ensure best viewing angle, free of reflections.

- 1 Press the blue segments on the right and left and
- 2 at the same time, tilt control panel to the desired angular position.



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## Preparation

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The following instructions cover

- Equipment assembly
- Electrical and gas connections
- Setting a language for the displayed texts
- Automated ventilator check with sensor calibration.

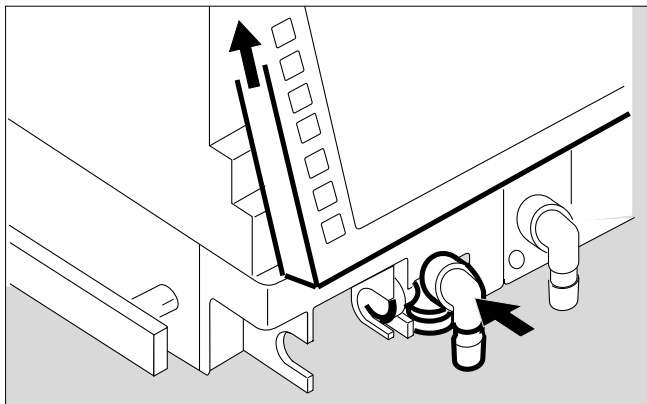
## Assembly of Components

### WARNING !

Always install components that have been cleaned and disinfected according to approved hospital procedures.

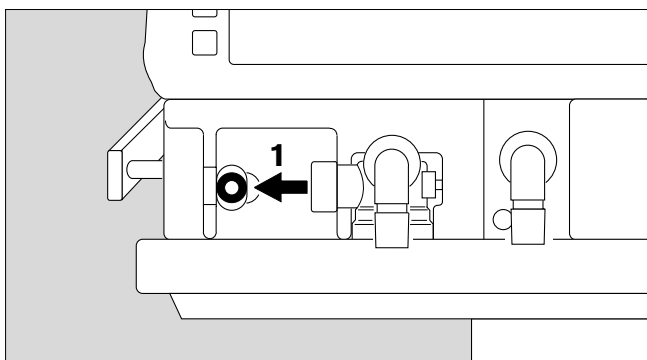
### Installing the Expiratory Valve

- Tilt the control panel upwards
- Push patient block fully into mounting receptacle. Check that it is properly engaged by gently pulling on the port. It should stay securely attached.



### Mounting a Flow Sensor

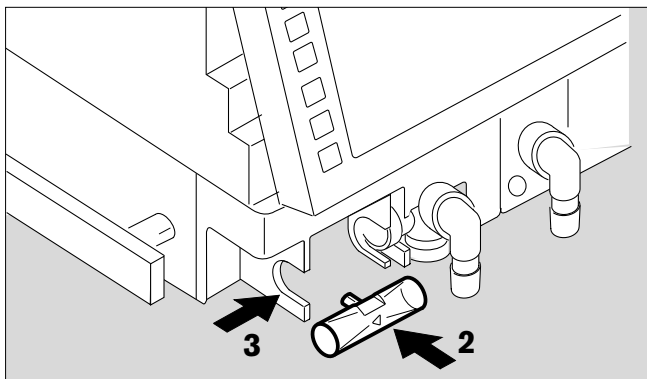
- 1 Push connector socket all the way to the left.



- 2 Gently push flow sensor into its mount – with the connector facing towards the ventilator – and into the socket, as far as it will go.

Then:

- 3 Push flow sensor to the right and into the rubber lip seal of the expiratory valve as far as it will go.



## Installing an O<sub>2</sub> Sensor Capsule

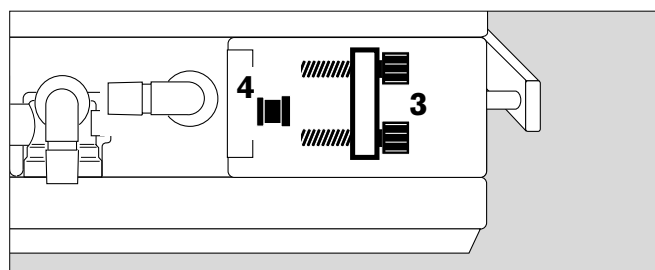
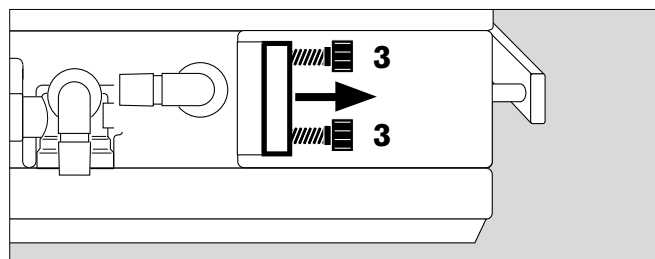
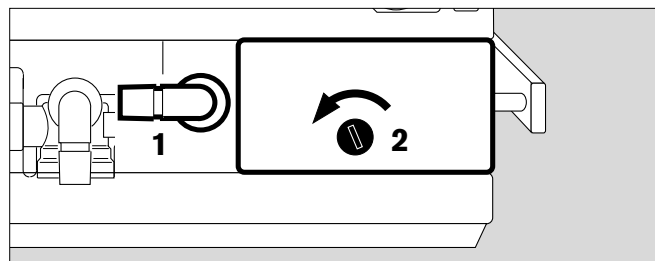
- when using the system for the first time
- when the display reads:  
**O<sub>2</sub> measurement inop**
- when calibration can no longer be performed.

- Tilt control panel upwards.
- 1 Turn port downwards or to the left.
  - 2 Use coin to loosen screw and remove protective cover.
  - 3 Loosen the two knurled screws and remove lid from the sensor chamber.
  - 4 Insert new sensor capsule.

**NOTE:** The sensor end with the circular contacts must be visible.

- 3 Close the sensor chamber securely with the two knurled screws.

- Screw protective cover back in place.



### CAUTION !

To prevent accidental blockage of air intake, protective cover must always be in place for operation.

- Dispose of used sensor, see page 152.

### WARNING !

**Treatment of batteries and O<sub>2</sub> sensor capsules:**

**Do not throw into fire! Risk of explosion.**

**Do not force open! Danger of bodily injury.**

**Follow all local, state, and federal regulations with respect to environmental protection when disposing of batteries and O<sub>2</sub> sensor capsules.**

## Precautions When Using Heat/Moisture Exchangers or Bacteria Filters

### Using Heat/ Moisture Exchangers

The use of a heat/moisture exchanger (HME) in the patient circuit can increase breathing resistance considerably.

An increase in breathing resistance will lead to increased work of spontaneous breathing and will require a greater trigger effort during assisted ventilation. Under unfavorable conditions, an increase in breathing resistance can also lead to intrinsic PEEP.

The operator must be aware that this breathing resistance in the patient circuit cannot be monitored by the ventilator.

- Therefore you should regularly check the condition of the patient and the ventilator's measured values for volume and resistance.

#### **WARNING !**

**Dräger cannot warrant or endorse the safe performance of heat/moisture exchangers.**

**The user must verify that the heat/moisture exchanger is covered by a technical safety certificate which guarantees complete suitability for the intended use.**

**Do not use a heat/moisture exchanger simultaneously with a nebulizer or heated humidifier!**

**Risk of increased breathing resistance due to condensation.**

- Follow the Instructions for Use of the heat /moisture exchanger (HME)!



## Potential Hazards from Use of Expiratory Bacteria Filters

The use of an expiratory bacteria filter is not mandatory.

Use of bacteria filters in the expiratory side of the patient circuit can cause an undesirable increase in breathing resistance.

Particularly when nebulizing aerosols or humidifying the breathing gas, resistance caused by a bacteria filter may slowly increase, leading to increased work of breathing and to intrinsic PEEP.

### **WARNING !**

**The flow resistance of bacteria filters placed in the expiratory side may be substantially increased by nebulized aerosols with the risk of impaired ventilation. If an expiratory filter is used during nebulization, airway pressures and flow should be monitored for any indication of increased expiratory resistance due to filter obstruction.**

Intrinsic PEEP may be recognized by the fact that expiratory flow has not returned to "0" at the end of expiration.

In case of unacceptably high PEEP, the ventilator will issue the alarm message:

#### **PEEP high**

- Check bacteria filter and exchange, if it proves to be the cause of high PEEP.

## Installing a Heated Humidifier

### WARNING !

Dräger cannot warrant or endorse the safe performance of third party humidifiers that are not described in this manual for use with the Evita 4 ventilator. Specifically, the user must assess the risks of delivery of breathing gas not maintained at a proper temperature associated with different humidifier designs. We strongly recommend using the electronic temperature monitoring feature of the ventilator if no proximal airway temperature monitoring is performed by the humidifier used.

Increased pneumatic resistance in the inspiratory line caused by a humidifier may result in less accurate airway pressure readings.

We recommend contacting the manufacturers/ distributors of third party humidifier devices about compliance of their products with the requested performance characteristics

- 1 Attach humidifier to mount below ventilator with rail clamp and secure clamp mechanism (screws, lever).
- 2 Swivel humidifier into desired position.
  - Prepare humidifier following its Operating Instructions.

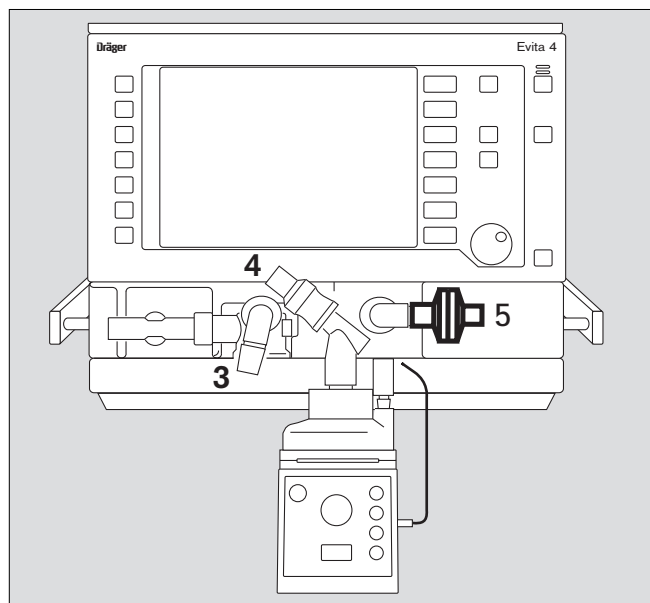
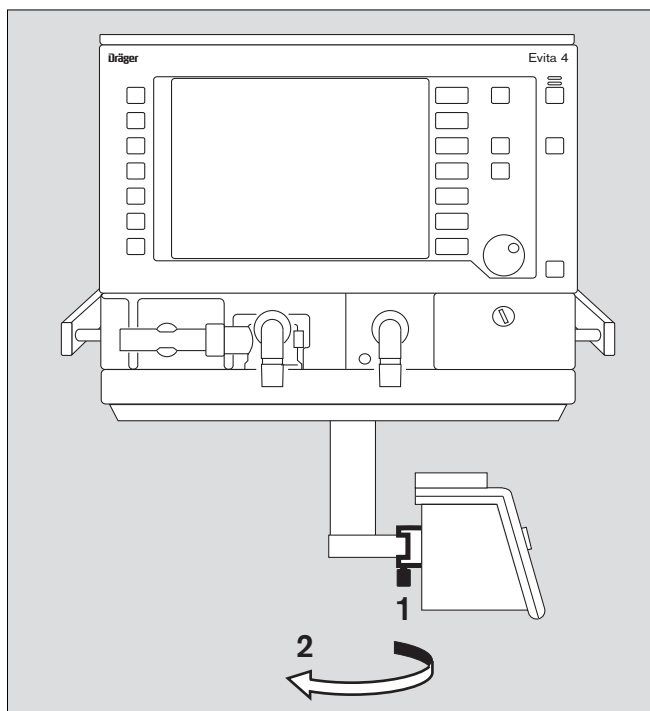
Depending on the position of the ventilator in relation to the patient bed, the hinged circuit support arm can be mounted to either side of the ventilator.

- 3 Turn expiratory port to the left or right, respectively (left showing).
- 4 Attach angled circuit connector of humidifier pointing into the direction desired (left showing).
- 5 Turn inspiratory port to the right and install a bacteria filter to the port.

**NOTE:** For the following descriptions it is assumed that the patient circuit has been attached on the **left-hand** side

### CAUTION !

Do not place containers of liquids on top of the Evita 4 ventilator. Liquids penetrating the ventilator can cause equipment malfunction and damage.



## Ventilating Adults and Children

Upward from 100 mL tidal volume VT

Patient mode: »Adults«

### WARNING !

Do not use a heat/moisture exchanger simultaneously with a nebulizer or heated humidifier!

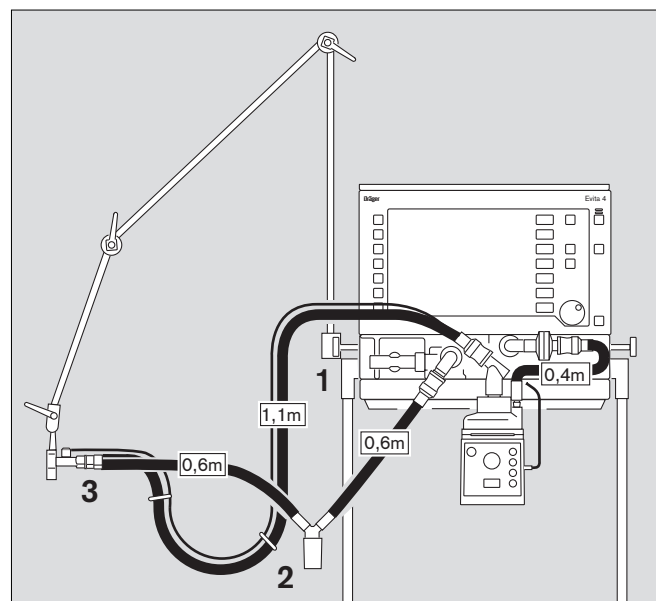
Risk of increased breathing resistance due to condensation.

## Connecting the Patient Circuit

### WARNING !

To avoid any risk of electric shock in the event of faulty grounding of patient monitoring equipment, do not use antistatic or electrically conductive patient circuits.

- 1 Attach circuit support arm to the rail on the left-hand side of the ventilator and tighten screws.
- Connect ventilator circuit segments of appropriate lengths (lengths suggested are in meters)
- 2 Install water trap(s) in vertical position.
- 3 Connect Y-piece, with the rubber sleeve of the Y-piece on the inspiratory side (reusable silicone circuit).

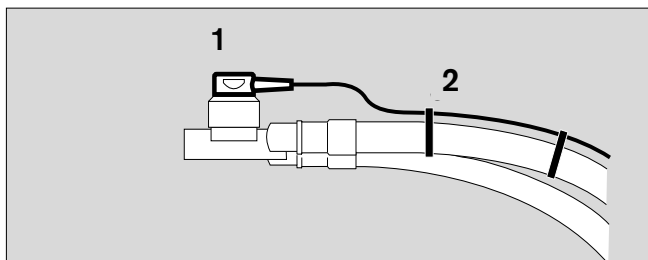


## Installing a Temperature Sensor

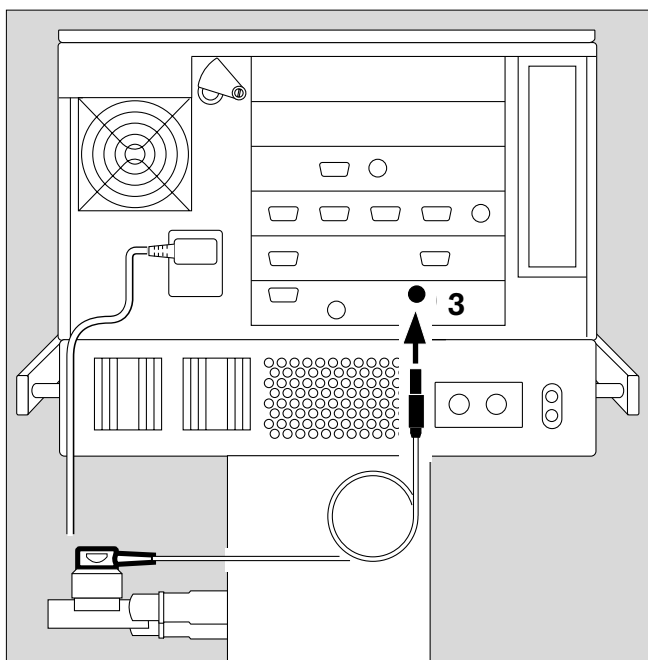
### WARNING !

We strongly recommend using the electronic temperature monitoring feature of the ventilator if no proximal airway temperature monitoring is performed by the humidifier used.

- 1 Push sensor as far as it will go into the rubber sleeve on the inspiratory side of the Y-piece. Align Y-piece so that the sensor is at the top.
- 2 Attach sensor cable with hose clips.

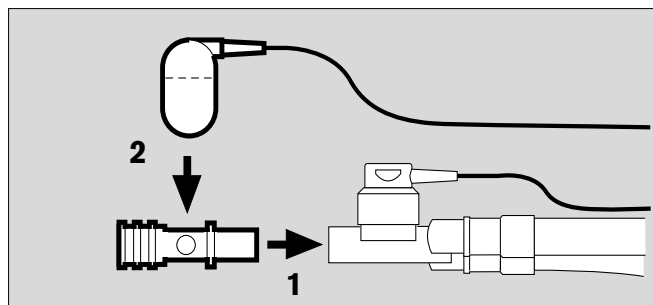


- 3 Insert plug of the temperature sensor into the socket at the rear of the unit.

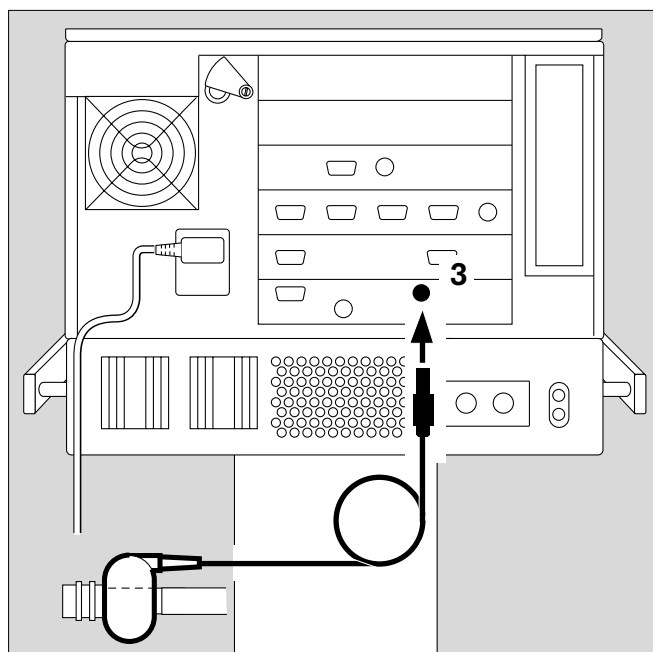


**Installing a CO<sub>2</sub> Cuvette and CO<sub>2</sub> Sensor  
(Available Option) (CapnoPlus)**

- 1 Fit the cuvette to the patient connection of the Y-piece, with the cuvette windows facing the side.
- 2 Push the CO<sub>2</sub> sensor on to the cuvette, with the cable trailing towards the ventilator.



- 3 Insert the plug of the CO<sub>2</sub> sensor in the CO<sub>2</sub> socket on the rear panel of the Evita 4.



## Ventilating Infants and Small Children

Up to 300 mL tidal volume VT

Patient mode »Pediatrics«

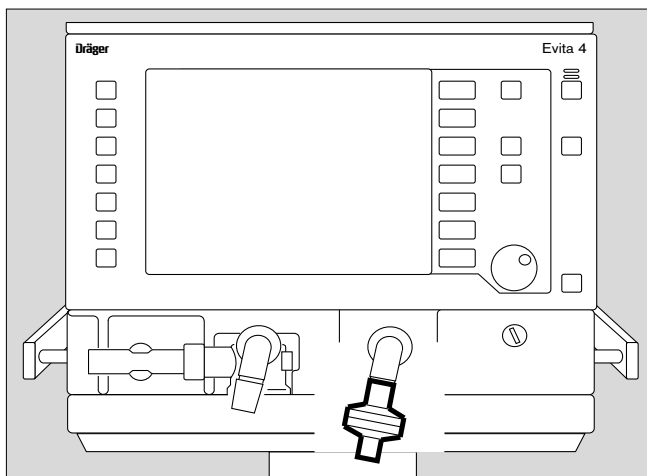
### WARNING !

Do not use a heat/moisture exchanger simultaneously with a nebulizer or heated humidifier!

Risk of increased breathing resistance due to condensation

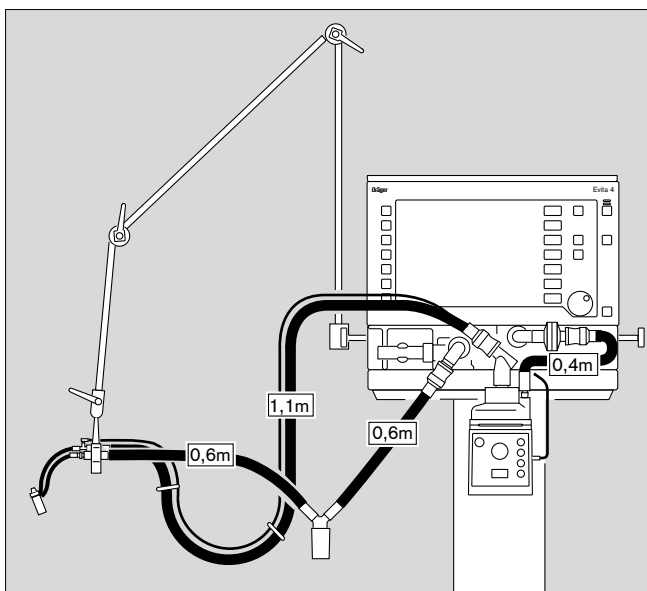
### Installing an Inspiratory Bacteria Filter

- Place bacteria filter on inspiratory port.



### Installing an Infant Patient Circuit

- Prepare the humidifier following its Operating Instructions, using infant size patient circuit connectors
- Clamp hinged circuit support arm to rail on the left-hand side and tighten screws.
- Connect ventilator circuit segments of appropriate lengths (lengths suggested are in meters)
- Install water trap(s) in vertical position.



## Supplies and Connections

### Electrical Power Supply

The ventilator is designed for a line voltage of:

either : 220 V to 240 V  
or : 100 V to 127 V

- Insert plug into the power outlet.

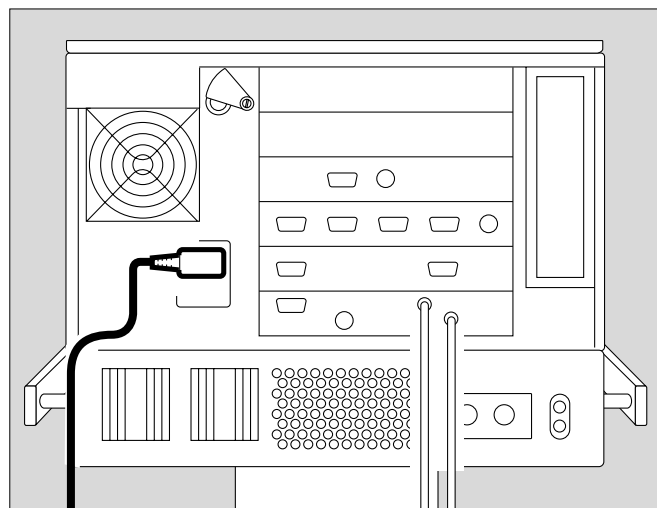
#### **WARNING !**

To maintain grounding integrity, connect only to a "hospital grade" receptacle. Always disconnect supply before servicing.

For operation with DC power unit and external battery (available option)

either : 12 V  
or : 24 V

- Connect the external battery with cable following Operating Instructions supplied with the DC power kit (part no. 84 13 034).



### Precautions When Using a Power Strip for Auxiliary Equipment

#### **WARNING !**

Connecting other devices to the same extension power strip may cause the leakage current to the patient to increase beyond the per-missible values in the event of grounding failure.

In this case, the risk of electric shock cannot be safely excluded.

## Temporary Interruption of Power Supply

e.g. when hospital backup power supply is activated.

### Without the 12/24 V DC power supply option:

During a power-out Evita 4 will trigger a continuous audible alarm of 2 minutes maximum.

If Evita 4 has been operating for less than 15 minutes, this time might be shorter.

Evita 4 tolerates power interruptions shorter than 10 milliseconds – without any effect on ventilation.

In the case of power interrupts exceeding 10 milliseconds, the ventilator will restart with a short self test lasting about 4 seconds – ventilation is then continued with the same values that were set before the power interruption.

If a lower alarm limit has been set for minute volume, the **MV low** alarm will be activated until the measured value for minute ventilation has again risen above the lower alarm limit.

### With 12/24 V DC power supply option installed:

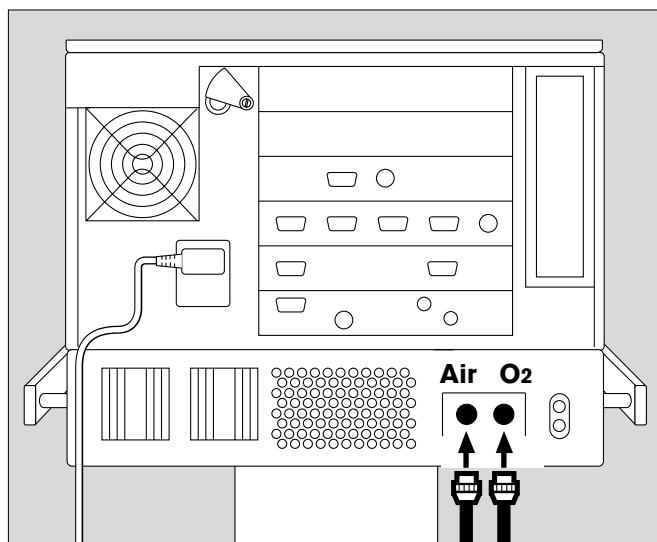
Follow Operating Instructions of Evita 4 DC option (DC power supply).

## Gas Supply

- Screw high pressure air and oxygen hoses to sockets on the back panel of Evita 4 and insert their probes into wall terminals.

### WARNING !

Always use medical grade oxygen and air that is dry and free from dust and oil. Contaminated gas may cause ventilator malfunction.







## Evita Remote (Available Option)

Optional (wired) remote control pad

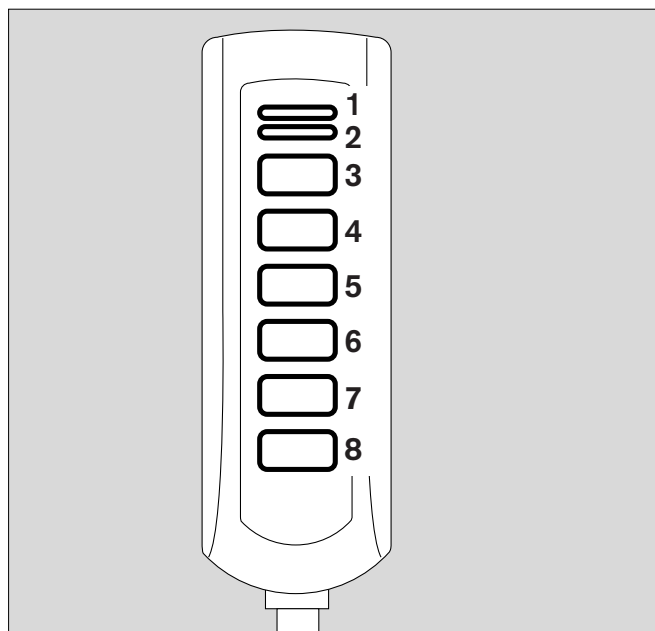
### WARNING !

Installation and activation of the Evita Remote kit should only be performed by DraegerService or factory trained and authorized service personnel.


Used for the remote, redundant control of the following indicators and key functions:

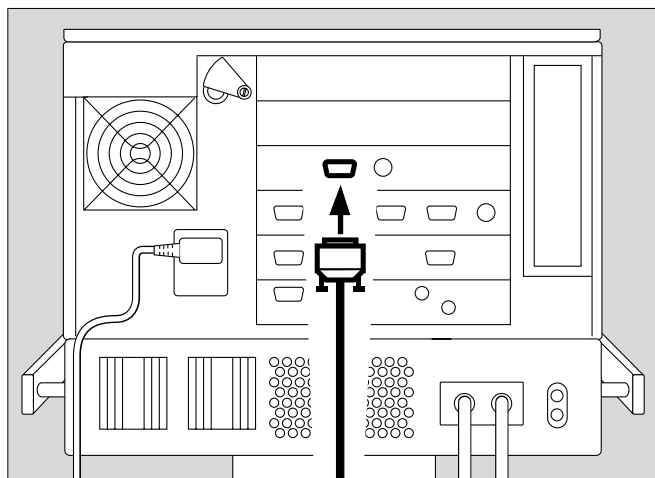
- 1 red indicator light – for signaling WARNING level alarm messages
- 2 yellow indicator light – for signaling CAUTION and Advisory level alarm messages
- 3 »« key – for silencing the audible alarm for 2 minutes
- 4 »Alarm Reset« key – for acknowledging alarm messages
- 5 » Neb.« key – for starting and stopping the nebulizing of medicated aerosols
- 6 »O2↑ Suction« key – for pre-/post oxygenation when performing bronchial suction
- 7 »Insp. hold« key – for manual insufflation
- 8 »Exsp. hold« key – for extending and holding an expiration

The function of the indicators and keys is equivalent to those of the respective control elements on the Evita 4 front panel and is described in the application chapters of this Operating Manual.



### Connecting

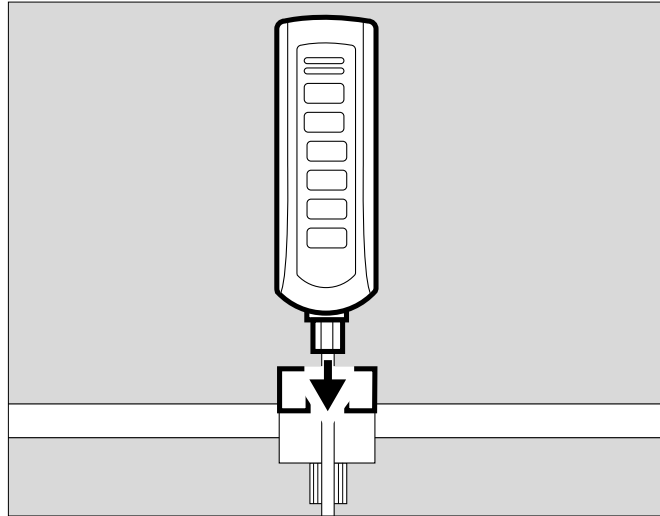
- Insert connector of the remote control pad cable into the »« receptacle on the back panel of Evita 4. The connector may be plugged or unplugged at any time without affecting ventilator function.



## Preparation

### Supplies and Connections

- Attach remote pad support bracket to a wall rail and tighten.
- Insert remote pad into its holder from the top.



Observe automatic check at power-up.

- when connecting the remote control pad to an operating ventilator

or

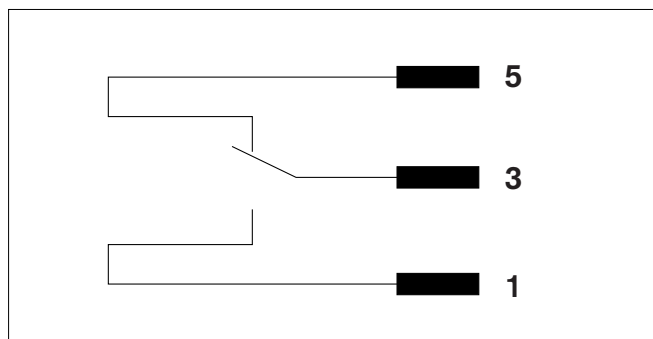
- when switching ventilator on with the remote control pad connected.
- Do not press any keys on the remote control pad.
- All lights in the remote pad will light up for 5 seconds:
  - red indicator light
  - yellow indicator light
  - yellow indicators in the keys.
- Evita 4 now checks the remote control pad. In case of a fault, an advisory message will be displayed, see page 155, "Troubleshooting".

## Nurse Call (Available Option)

Connection on the rear panel of Evita 4 intended for the transmission of alarm messages with highest priority (alarm level) to a central hospital alarm system.


### WARNING !

**Installation of the Evita nurse call kit should only be performed by DraegerService or factory trained and authorized service personnel.**



- Have a qualified electrician perform the installation of the round 6-way DIN female connector to the line of the central alarm system.

Evita 4 activates the nurse call by closing contacts 3-5 whenever a level alarm is displayed.

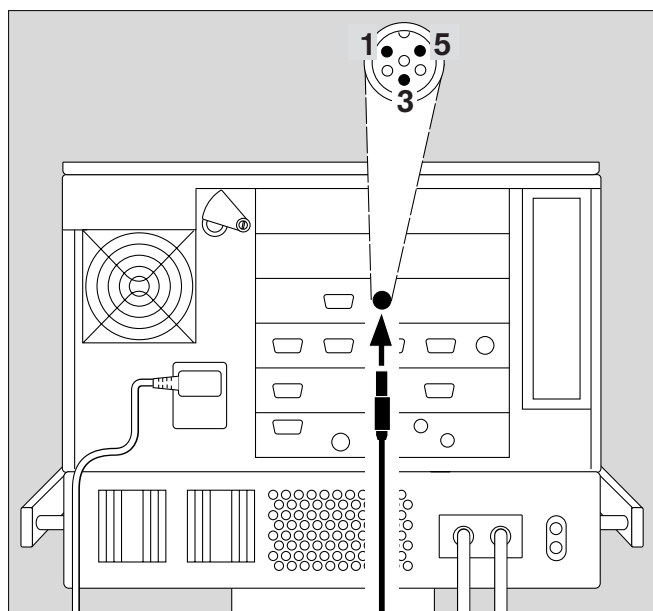
- Connect plug to the receptacle marked »  « and secure with screws.
- Check connected nurse call system for proper operation.

### WARNING !

**The operator of the ventilator must still assume full responsibility for ventilation monitoring via the Evita 4 screen when the nurse call is connected.**

**Only alarm messages of the highest priority (see page 93) are transmitted via nurse call.**

- Check screen displays frequently.



Alarms that are transmitted via nurse call are those indicated in red and with three exclamation marks in the top field of the Evita 4 screen. Caution and Advisory level messages are not transmitted. The nurse call is also activated when the internal loudspeaker in the ventilator is defective.

**A fault in any of the components in the link between nurse call and central hospital alarm system (e.g. in the electronics for nurse call in Evita, in the Evita power supply, or in the alarm generator of the central hospital alarm system) may result in failure of the nurse call.**

Background: The hospital connections to the central alarm typically use only one channel. The electronics for nurse call consequently also uses only one channel.

## Technical Data

Potential-free DC contact

Input voltage

max. 40 V DC

Input current

max. 500 mA

Switching power

max. 15 W

## Before Using for the First Time

### Selecting the Screen Language

Evita 4 (US version) leaves the factory programmed with American English screen texts.

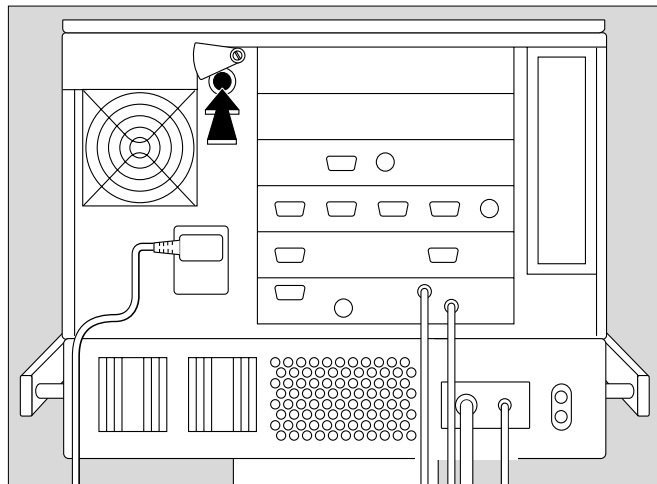
Alternatively, the following languages can be selected:

- **English (international)**
- **German**
- **French**
- **Italian**
- **Spanish**
- **Dutch**
- **Swedish**
- **Japanese**
- **Greek**
- **Russian**
- **Portuguese**
- **Arabic**
- **Chinese**
- **Turkish**

- Switch ventilator on by pressing power switch on the back panel until it clicks into position.  
Protective cover will swivel over the button to protect against inadvertent switching off (to switch off, pivot cover upwards and press button fully in).

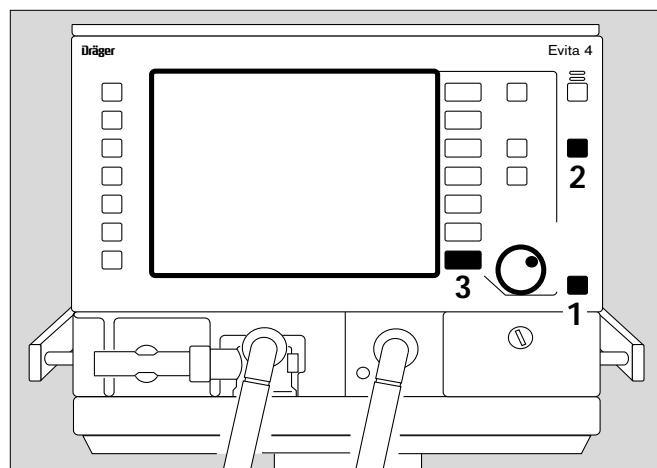
Evita 4 now runs a self test,

- Wait until the 10-second test is complete.



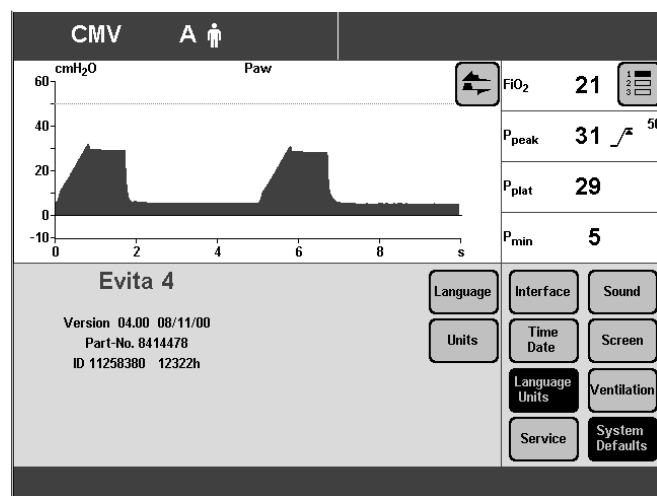
After the self test:

- 1 To switch Evita 4 to Standby, hold down »**Stand by**« key for about 3 seconds.
- 2 Switch off standby audible alarm with »**Alarm Reset**« key.
- 3 Press »**Configuration**« key.



- Touch »**System Defaults**« screen key.
- Touch »**Language/Units**« screen key.
- Touch »**Language**« screen key.
- Select desired language by turning dial knob .  
Press dial knob to confirm.  
The selected language is now activated.

**NOTE:** Ask DraegerService or your factory authorized technical service center if you would like to change the language on control panel key labels.



## Checks of Readiness for Operation

### Before use on a patient

Immediately before using on the patient, check that the ventilator is working properly and is ready for operation.

#### **WARNING !**

**The ventilator is ready for operation only when:**

- **it is completely assembled with all required auxiliary equipment in place,**
- **all sensors are calibrated (O<sub>2</sub>, Flow, CO<sub>2</sub>)**
- **the »device check« has been completed successfully.**

Evita 4 supports this ventilator check with a built-in checklist that guides the user through the tests of readiness for operation in a dialog fashion.

During the device check, Evita 4 performs the following tasks:

- Check for completeness of ventilator assembly
- Test of the audible alarm
- Test of the expiratory valve
- Test of the Air/O<sub>2</sub> switchover valve
- Test of the safety relief valve
- Flow sensor calibration
- O<sub>2</sub> sensor calibration
- CO<sub>2</sub> sensor calibration
- Leak test of the patient circuit
- Check of patient circuit compliance and resistance.

**NOTE:** The test results obtained from this device check and the calibration and zero-checking values of the sensors remain stored until the next calibration – even if the ventilator is switched off.

If the patient circuit is modified after performing the device check, the type of humidification is changed, or the patient mode is changed, the patient circuit leak test must be repeated before using the ventilator system.

## Preparing for the Check Procedure

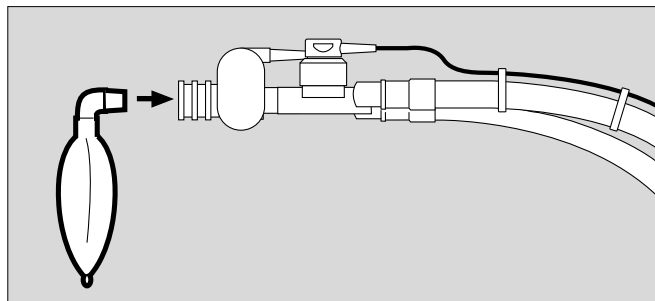
### Preparing the adult test lung 84 03 201

for the adult patient circuit

The test lung assembly consists of an elbow connector for connection to the Y-piece, a 7 mm diameter ET-tube connector for simulating airway resistance and a 2 liter breathing bag to simulate compliance.

**NOTE:** Do not use permanently stretched breathing bags, these might cause artifacts during the check procedures.

- Insert the elbow connector into the Y-piece only when Evita 4 advises you on screen to do so.

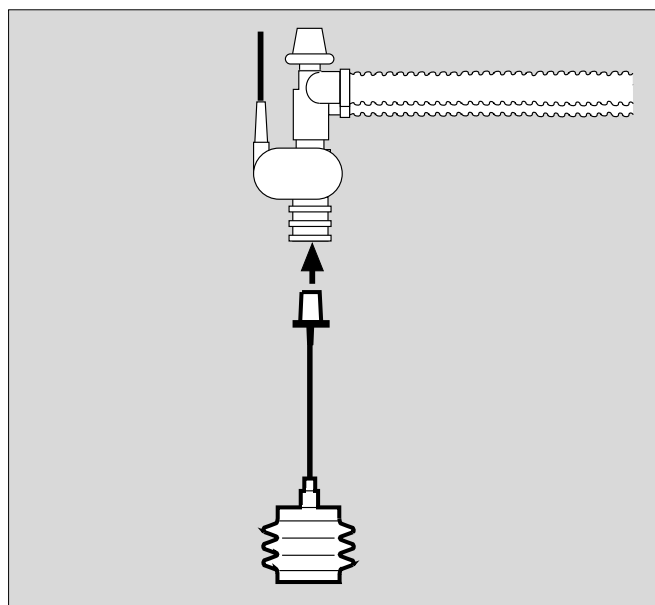


### Preparing the infant test lung 84 09 742

for use with the infant patient circuit

The test lung consists of a tracheal tube CH 12 to simulate airway resistance and a small bellow to simulate compliance.

- Insert the elbow connector into the Y-piece only when Evita 4 advises you on screen to do so.

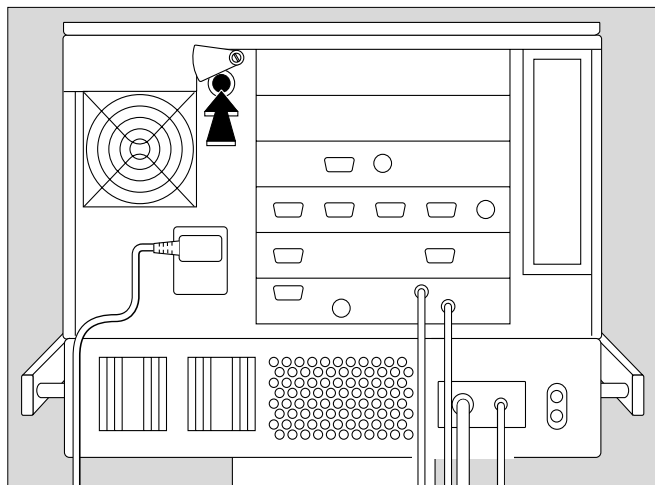


## Performing Ventilator Check

- Switch ventilator on by pressing power switch on the back panel until it clicks into position.

Evita 4 runs the self test.

- Wait until the 10-second test has been completed.

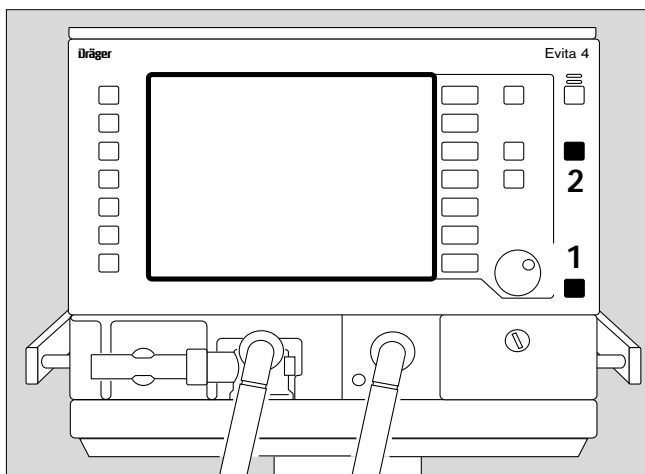


## Preparation

### Checks of Readiness for Operation

After the self-test:

- 1 Switch Evita 4 to standby by holding down »**Standby**« key for about 3 seconds.
- 2 Switch off standby audible alarm with »**Alarm Reset**« key.
- Touch »**Device check**« screen key.



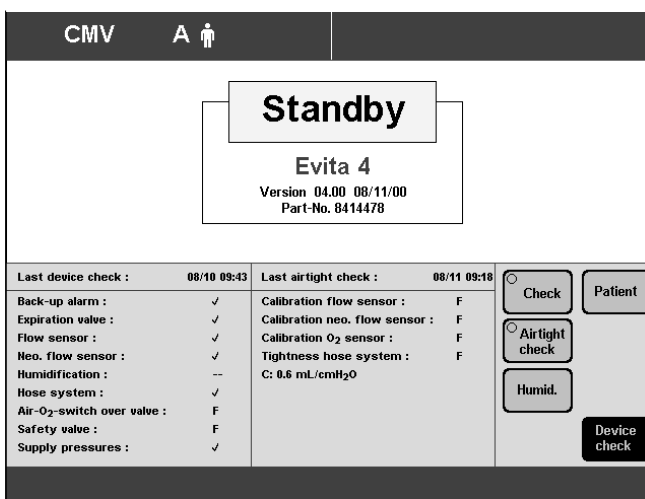
Display:

Enter the chosen type of humidifier before starting the check procedures:

- Heated (active) humidifier or
- HME/filter (passive, artificial nose)

Knowing the type of humidifier used, the ventilator is able to take into account the respective conditions regarding humidity and temperature when performing volume measurements.

- Touch »**Humid.**« screen key.



Display:

- Touch screen key »**Active Humid.**« or
- touch screen key »**HME/Filter**«.
- Press dial knob to confirm selection.

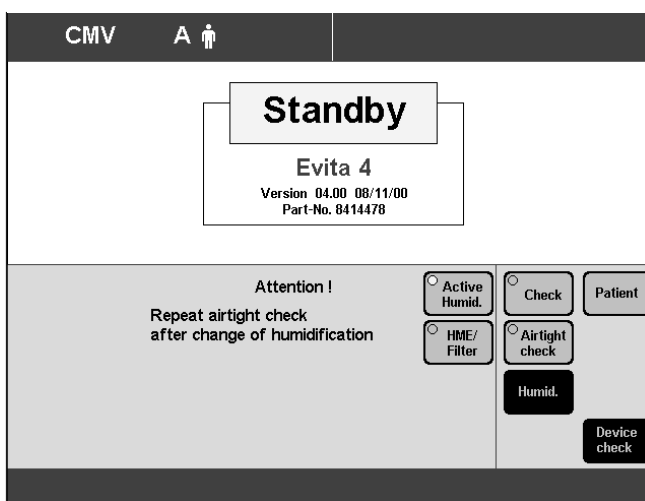
The ventilator marks the selected type of humidifier with a yellow LED in the screen key.

The humidifier type selection remains stored and will be in effect upon restarting the ventilator.

In case of a change in the type of humidification requiring a renewed on-screen selection after the ventilator check, the ventilator marks the following test steps as invalid (– –).

- humidification
- leak test.

This suggests to repeat the device check for these two tests.





Start the test procedure:

- Touch »**Check**« screen key.

Evita 4 starts running through the tests in dialog with the operator.

The test procedure is semi-automatic.

During the device check, the operator is instructed by Evita 4 to perform specific actions on the device.

The following tests are performed during the device check:

- Proper operation of auxiliary and power failure alarms
- Expiratory valve fit and throughput
- Fit of flow sensor
- Fit of neonatal flow sensor (for "NeoFlow" option)
- Type of humidifier
- Completeness of patient circuit
- Test of Air/O<sub>2</sub> switchover valve
- Test of safety relief valve
- Check of gas supply pressure
- Flow sensor calibration
- Calibration of neonatal flow sensor (for "NeoFlow" option)
- O<sub>2</sub> sensor calibration
- Pressure test of patient circuit

Upon completion of the ventilator check, a checklist is displayed on screen to show the test results.

Correct result : ✓  
 Incorrect result : F  
 Skipped checkpoint : --

In the event of deficient results, e.g. if the patient circuit is leaking:

- Eliminate the cause of the problem
- Touch »**Repeat check**« screen key.

**NOTE:** Only tests with deficient results are repeated.

**After successful completion of the device check, Evita 4 is ready for operation.**

Either:

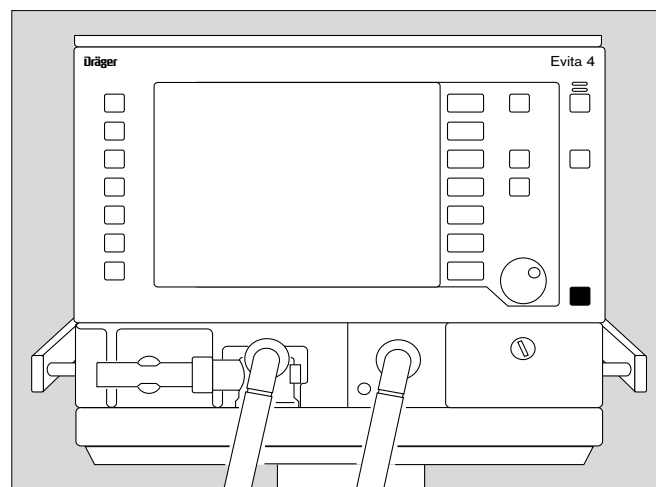
- immediately start up Evita 4 by pressing »**Stand by**« key

or:

- leave Evita in standby mode

or:

- switch off Evita for later use.  
 Switch on the back panel = pivot cover to the side, then press button in fully and release.



#### Testing patient circuit for leaks

The patient circuit is tested for leaks as part of the standard ventilator check procedure, but it should also be tested independently, e.g. after exchanging the patient circuit.



Touch »**Airtight check**« screen key.

During the test, Evita 4 continuously displays leakage flow.

A leakage flow up to 300 mL/min at a pressure of 60 cmH<sub>2</sub>O is acceptable.

After the leak test, Evita4 determines compliance and resistance of the patient circuit.

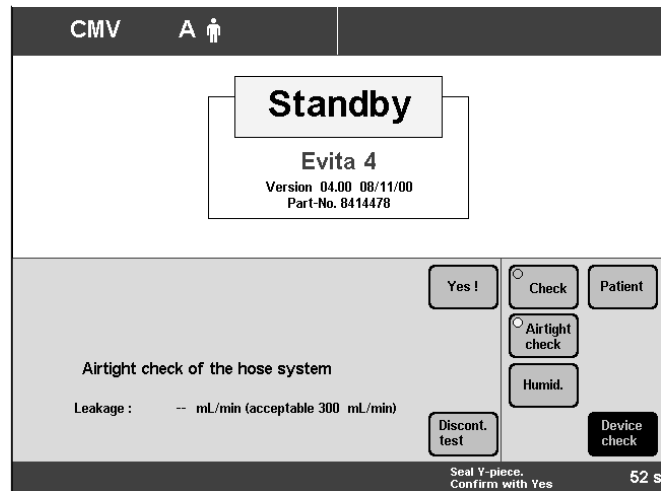
Evita 4 uses the calculated compliance value to automatically correct volume controlled ventilator breaths, as well as values measured as part of flow monitoring, see page 190.

Evita 4 uses calculated patient circuit resistance for correcting pressure values measured in the presence of a base flow (NeoFlow option).

**NOTE:** When changing patient mode or type of humidifier, the ventilator automatically resets values for patient circuit compliance and resistance to their defaults.

Performing the patient circuit leak test, the ventilator will determine the current values for compliance and resistance. Therefore:

**Always perform leak test when exchanging patient circuit or changing patient mode.**



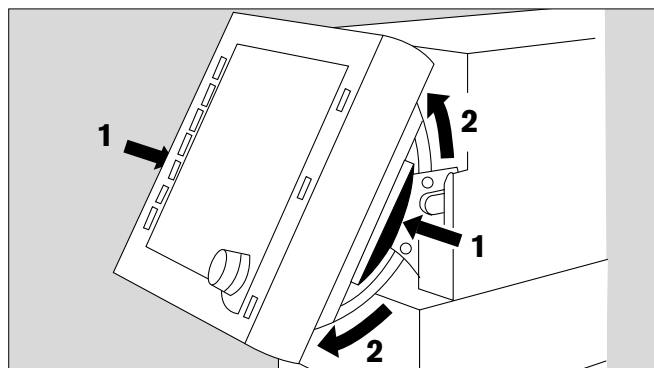
## Positioning The Control Panel

### CAUTION !

Do not drop control panel - physical damage to the unit is likely.

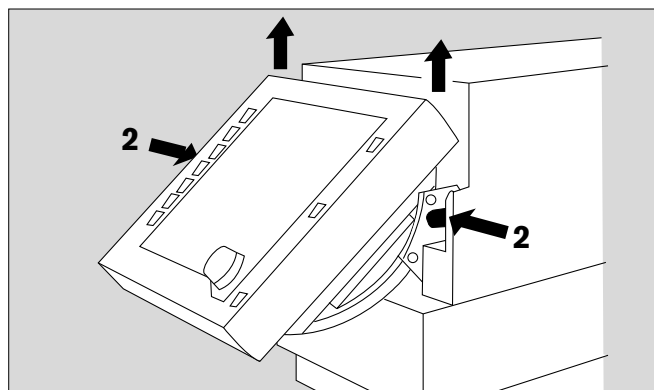
Do not allow control panel to lean against any objects in an upright position.

When changing panel, lay it on its back.



### Mounting the Control Panel to a Wall Rail

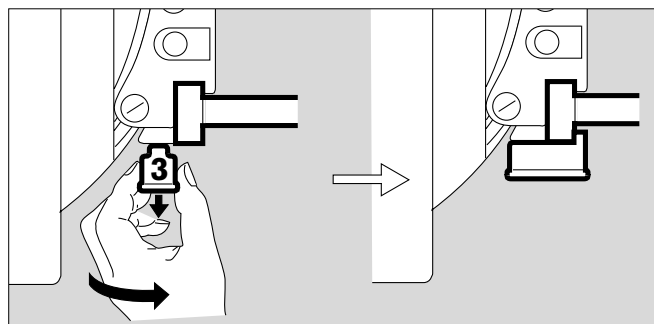
- 1 Press blue segments on the right and left, and tilt control panel fully downwards.
- 2 Hold down release buttons on the left and right, and remove control panel from its mounts on the Evita 4 main unit.
- Uncoil the cable as far as necessary.
- Mount the control panel to the wall rail and
- 3 lock in place by pulling down the latch situated beneath the bracket and turning it in the direction of the wall rail.



### Tilting the Control Panel

- 1 Press segments on the right and left and, at the same time, tilt control panel to desired position.

**NOTE:** The control panel rail clamps are designed for use with 25 x10 mm wall rails.



### Mounting the Control Panel to the Ventilator

- Press blue segments on the right and left and tilt control panel fully downwards.
- To release control panel, turn latch away from the wall rail and lift control panel off the rail.
- Coil the cable.
- Hang control panel into its mounts on the Evita 4 main unit until it clicks into position.
- Press segments on the right and left and, at the same time, tilt the control panel to the desired position.

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## Operation

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## Precautions During Operation

### WARNING !

Always use ventilator that has been cleaned and disinfected and has been successfully tested to be ready for operation.

### WARNING !

Always heed all precautions and follow all hospital protocols with respect to the administration of oxygen. Make adjustments to the FiO<sub>2</sub> according to the blood gas values measured.

### WARNING !

In case of malfunction of any of the built-in monitoring a substitute is recommended to maintain an adequate level of monitoring. The operator of the ventilator must still assume full responsibility for proper ventilation and patient safety in all situations.

### WARNING !

Do not block air intake. Ventilator malfunction will result.

### WARNING !

If a fault is detected in the ventilator and its life-support functions are in doubt, ventilation must be started without delay with an independent ventilation device (resuscitation bag) - using PEEP and/or increased inspiratory O<sub>2</sub> concentration where necessary and appropriate. The unit should then be removed from use and serviced by factory trained and authorized personnel.

### CAUTION !

Do not place containers of liquids on top of the Evita 4 ventilator. Liquids penetrating the ventilator can cause equipment malfunction and damage.

### WARNING !

- Always use extreme caution when using oxygen!
- Oxygen intensely supports any burning! No smoking, no open fire in areas where oxygen is in use!
- Always provide adequate ventilation in order to maintain ambient O<sub>2</sub> concentrations < 24 %.
- Always secure O<sub>2</sub> cylinders against tipping, do not expose to extreme heat.
- Do not use oil or grease on O<sub>2</sub> equipment such as tank valves or pressure regulators. Do not touch with oily hands. Risk of fire!
- Open and close valves slowly, with smooth turns. Do not use any tools.

#### Routine checks during operation

- About every hour, check inspiratory gas temperature.
- About every 2 hours, empty water traps in patient circuit.
- Periodically inspect O<sub>2</sub> and Air inlet water traps. Drain water from bowls when necessary.

## Starting Up

### Switching On

- Push power switch button on back panel until it engages = ON.  
The protective cover will swivel over the switch button to prevent the ventilator from being inadvertently switched off.

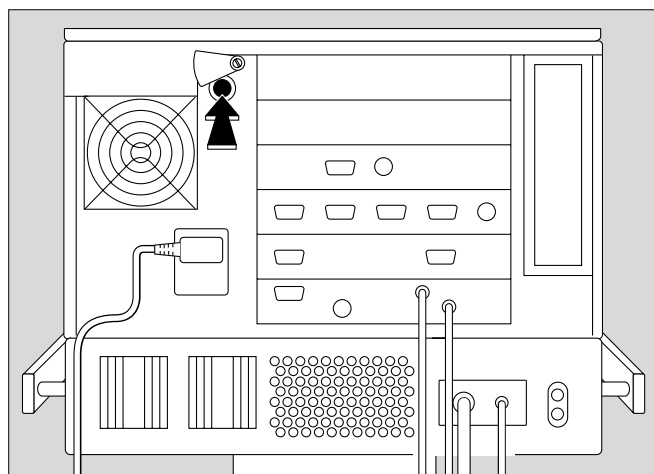
Evita 4 now performs the self-test.

- Wait until the 10-second test is completed.

Evita 4 always begins ventilation with the startup defaults marked by an arrow on the on-screen knobs.

To configure startup default values, please refer to page 133.

After power outs or periods of standby, the ventilator will use the settings in effect immediately before the interruption of ventilation.



### Patient Mode

For factory delivered ventilators, Evita 4 offers the following patient modes after power-up.

- »Adults« = adult patient
- »Peds.« = pediatric patient
- »Neo.« = neonatal patient (with NeoFlow option)
- »Previous« = previous patient

Simultaneously, the ventilator asks to enter the weight of the patient (ideal body weight).

Example:

Ventilation of an adult patient.

With this information, Evita 4 determines the ranges of adjustment and the startup values of the ventilation parameters.

The startup defaults with respect to the selected patient mode may be configured by the user, see "Configuration" on page 132.



The »**Previous Patient**« screen key offers the option to restore all patient related settings including alarm limits and monitoring status from the time before the ventilator was last switched off.

Example:

Previous patient

In the status field, the previous mode settings appear:

- previous ventilation mode
- previous patient mode
- previous application mode (tube or mask if NIV option is installed)



In case of data loss or removal of a previously available option (e.g. NeoFlow), Evita 4 will prevent restoration of previous setting by not showing the »**Previous Patient**« key. Evita 4 will also not allow previous settings if the ventilator was configured in such a way that the previous patient mode is not available any more (i. e. previous patient mode was removed from the list of selectable patient modes during startup).

## Selecting the Patient Mode

If this selection has been configured,

either

- touch respective screen key:
  - »**Adults**«, or
  - »**Peds.**«, or
  - »**Neo.**«, (with option NeoFlow installed) and

enter ideal body weight (if configured)

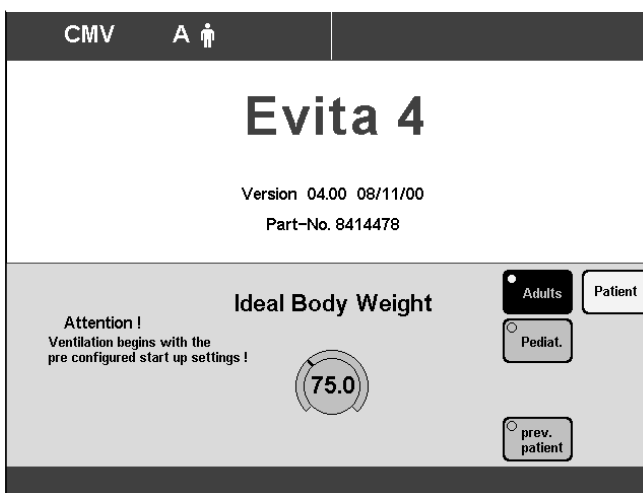
With the information about a patient's ideal body weight, Evita 4 determines the startup settings of the ventilation parameters. The startup values are marked on screen knobs with an arrow (►).

- Touch screen knob.
- Turn dial knob to enter ideal body weight [kg].
- Press dial knob to confirm setting.

or:

select previous settings

- Touch »**Previous Patient**«
- Press dial knob to confirm.

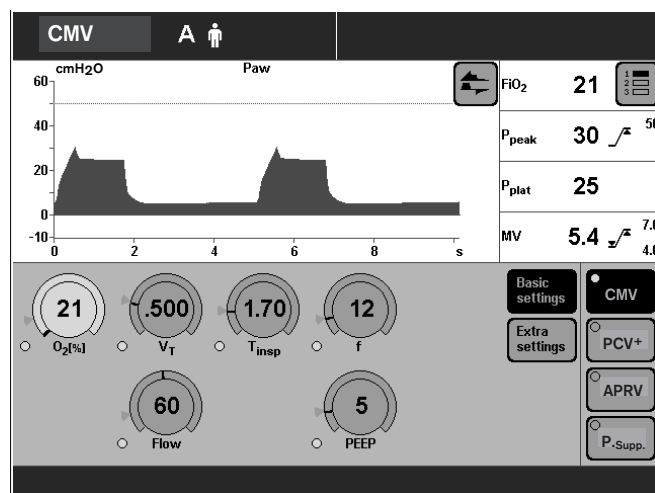




## Starting Ventilation

- Press dial knob again.  
Evita 4 starts ventilation with the default ventilation mode configured by the user.

Evita 4 then displays the »Settings« screen page. The user may now check and correct the settings showing on screen.



## Setting Ventilation Modes

The ventilation modes CMV, PCV+ (BIPAP), SIMV, and Pressure Support are already factory-configured in the ventilator. If other ventilation modes are to be used, please refer to page 127 "Selecting Ventilation Modes".

### CMV

#### Continuous Mandatory Ventilation

Volume controlled ventilation with fixed, mandatory minute volume MV and user-adjustable tidal volume VT and ventilator rate (frequency) f used for patients without spontaneous breathing.

Set the ventilation pattern for CMV with the parameters:

Tidal volume »VT«

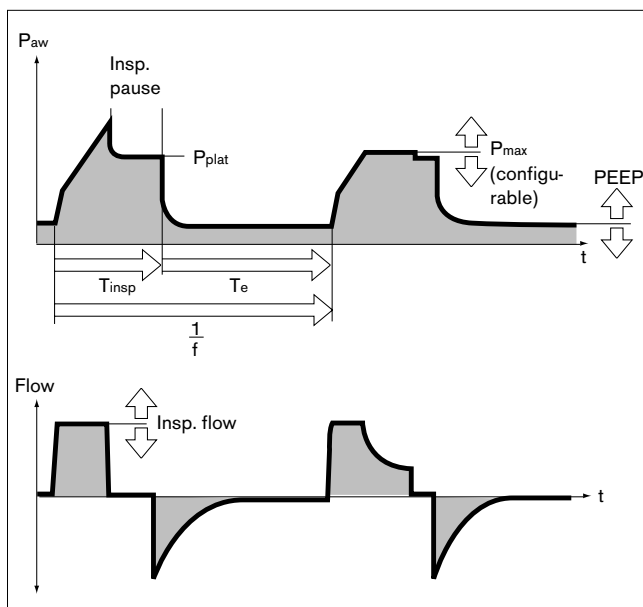
Insp. Flow »Flow«

Ventilator rate »f«

Inspiratory time »T<sub>insp</sub>«

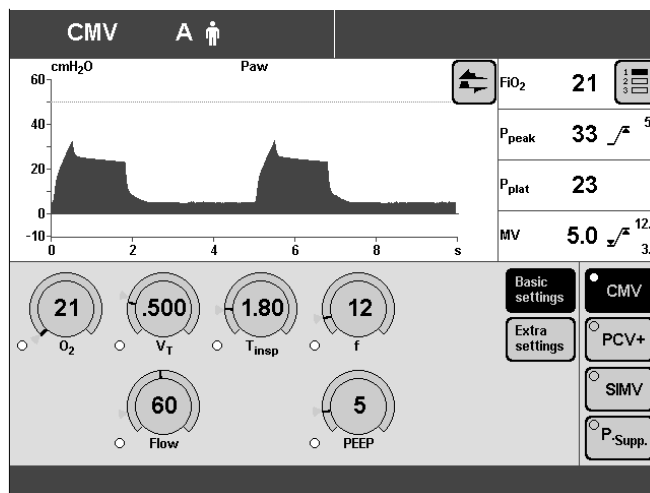
O<sub>2</sub> concentration »O<sub>2</sub>«

Positive end-expiratory pressure »PEEP«



To set:

- Touch the respective screen knob.
- Turn dial knob to set value.
- Press dial knob to confirm value.

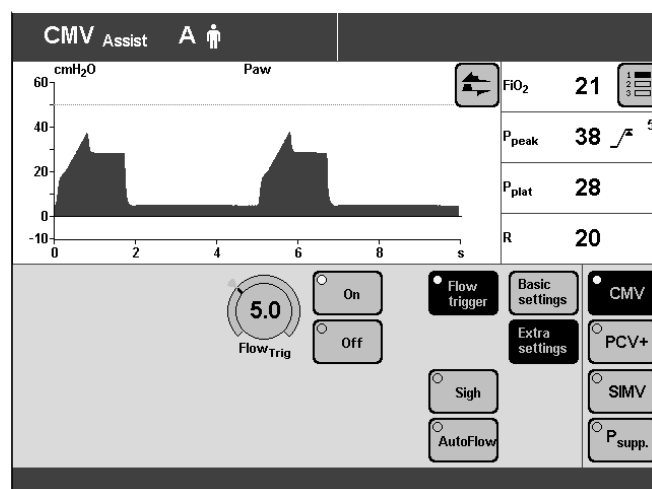


CMV may be extended with the following ventilation parameters:

**Flow trigger** (CMV Assist) – for synchronization with a patient's spontaneous breathing efforts.

Switching on flow trigger and setting a trigger level will synchronize mandatory breaths with the patient's spontaneous breaths.

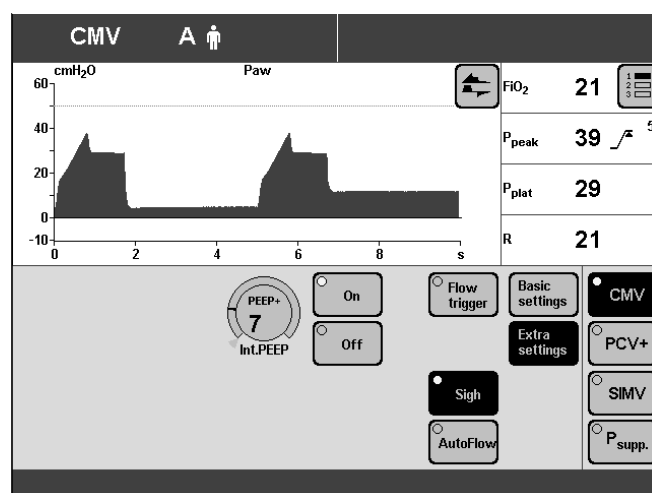
A patient's spontaneous breathing efforts are indicated by briefly displaying a lung symbol in place of the patient mode symbol.



**Intermittent PEEP** – for prophylactic treatment of atelectasis.

Switching on and setting an intermittent PEEP may help prevent atelectasis.

Intermittent PEEP, when activated, will increase end-expiratory pressure for two ventilator breaths every 3 minutes by the value set for intermittent PEEP.



**AutoFlow®** – for automatically optimizing inspiratory flow.

With AutoFlow\*, inspiratory flow is decelerated and controlled in such a way that the set tidal volume VT is delivered at a minimum airway pressure for a given patient lung compliance while avoiding pressure peaks. Evita 4 delivers additional inspiratory flow during spontaneous inspirations – limited by the alarm limit VT<sub>i</sub>  $\sqrt{}$ . The patient can also exhale during the inspiratory plateau. Inspiratory pressure is limited by the alarm limit for Paw  $\sqrt{}$ .

- Set alarm limits MV  $\sqrt{}$  and MV  $\sqrt{}$  to avoid over- or under-ventilating a patient with a rapidly changing compliance.

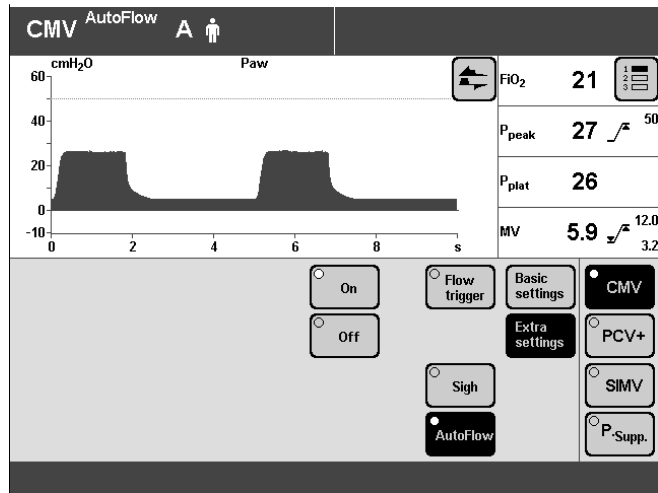
\* For a detailed description of AutoFlow and PLV, see page 180.

To set:

- Touch »**Extra settings**« screen key.
- Touch screen key corresponding to the desired function.

For flow trigger and intermittent PEEP:

- Touch respective screen key
- Turn dial knob to set value, and
- press dial knob to confirm value.
- Touch »**On**« screen key to switch function on, and
- press dial knob to confirm.



CMV can be configured with the additional ventilation parameter  $P_{max}$  for pressure limited ventilation. For selecting » $P_{max}$  pressure limiting«, see page 129.

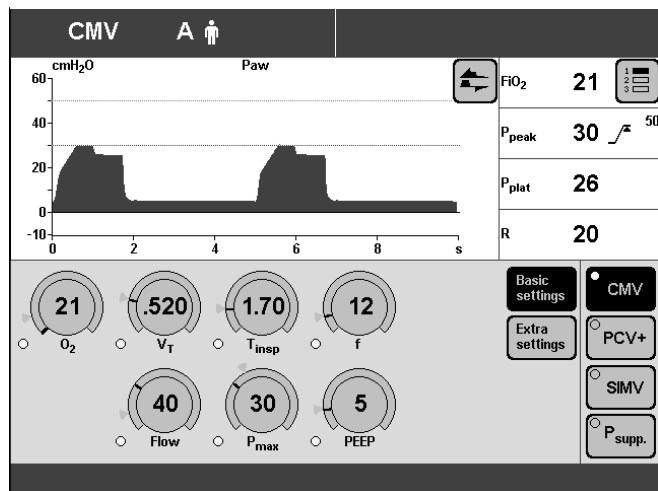
**Pressure Limited Ventilation (PLV)\*** – for manually limiting pressure peaks using the  $P_{max}$  pressure limit. The tidal volume remains constant as long as the pressure waveform shows a plateau and the inspiratory flow waveform shows a brief flow pause between inspiration and expiration.

- Set pressure limit  $P_{max}$ , see page 129.

The value for  $P_{max}$  will appear as a dashed, blue line in the  $P_{aw}(t)$  waveform.

Volume monitoring is always active. A "Volume not constant" alarm is triggered automatically if the tidal volume  $V_T$  can no longer be delivered.

The visual and audible portion of the alarm can be muted with the »**Alarm Reset**« key until the cause for the alarm has been corrected.



\* For a detailed description of AutoFlow and PLV, see page 180.

## SIMV, SIMV/P.Support.

### Synchronized Intermittent Mandatory Ventilation\* Pressure Support\*\*

Fixed mandatory minute volume MV set with tidal volume VT and ventilator rate f. Between mandatory ventilator breaths, the patient can breathe spontaneously, thereby contributing to the minute volume. Spontaneous breathing can be augmented with Pressure Support.

Used for patients with insufficient spontaneous breathing or for patients to be weaned by incrementally reducing the mandatory portion of the total minute volume.

In the course of the weaning process, the ventilator rate may be reduced down to 0. The ventilator will then automatically switch to CPAP or CPAP/P.Support. ventilation mode and it will also indicate this new ventilation mode.

**NOTE:** The »SIMV« screen key and the screen knobs for SIMV ventilation parameters will continue to be displayed.

Set the ventilation pattern for SIMV and SIMV/P.Support. with the parameters:

Tidal volume »VT«

Insp. flow »Flow«

Breath rate »f«

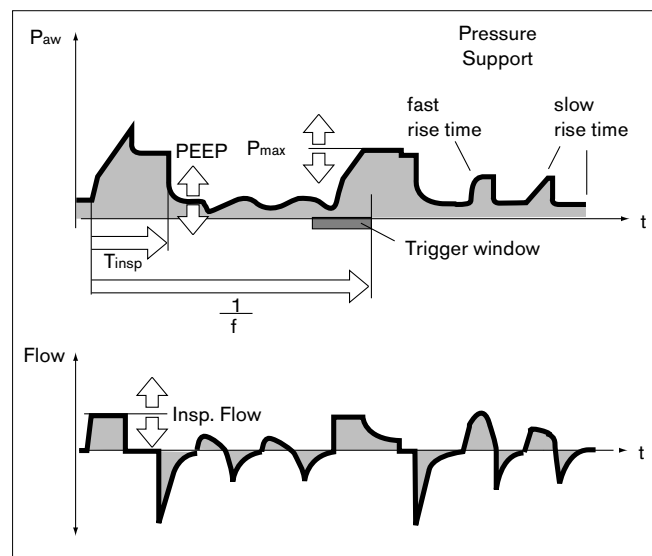
Inspiratory time »Tinsp«

O2-concentration »O2«

Positive end-expiratory pressure »PEEP«

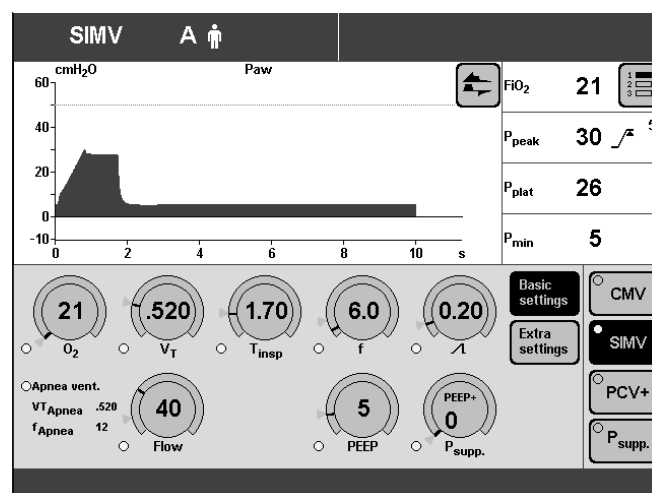
Support pressure »Psupp.«

Pressure rise time » $\Delta$ «



To set:

- Touch the respective screen knob.
- Turn dial knob to set value.
- Press dial knob to confirm value.



\* Please refer to page 184 for a detailed description of SIMV.

\*\* Please refer to page 184 for a detailed description of Pressure Support.

SIMV and SIMV/P.Supp. can be extended with the following ventilation parameters:

**Flow trigger** – for synchronization with a patient's spontaneous breathing efforts.

Switching on flow trigger and setting a trigger level will synchronize mandatory breaths with the patient's spontaneous breaths.

A patient's spontaneous breathing efforts are indicated by briefly displaying a lung symbol in place of the patient mode symbol.

**Apnea Ventilation** – for automatic switch to volume controlled mandatory ventilation if the patient stops breathing.

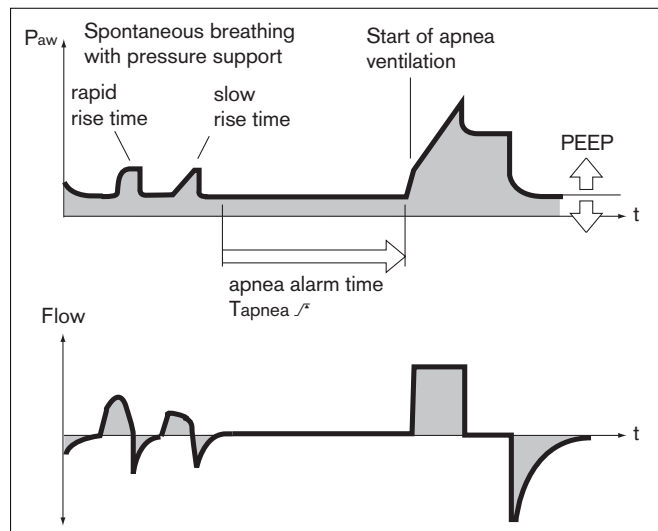
If breathing stops, Evita 4 will trigger an alarm after the set alarm time ( $T_{\text{apnea}} \setminus^\circ$ ) and will start volume controlled ventilation with the set ventilation parameters:

Breath rate » $f_{\text{Apnea}}$ «

Tidal volume » $VT_{\text{Apnea}}$ «

**AutoFlow®** – for automatically optimizing inspiratory flow. With AutoFlow\*, inspiratory flow is decelerated and controlled in such a way that the set tidal volume VT is delivered at a minimum airway pressure for a given patient lung compliance while avoiding pressure peaks. Evita 4 delivers additional inspiratory flow during spontaneous inspirations – limited by the alarm limit  $VT_i \setminus^\circ$ . The patient can also exhale during the inspiratory plateau. Inspiratory pressure is limited by the alarm limit for  $P_{\text{aw}} \setminus^\circ$ .

- Set alarm limits  $MV \setminus^\circ$  and  $MV \setminus^\circ$  to avoid over- or under-ventilating a patient with a rapidly changing compliance.

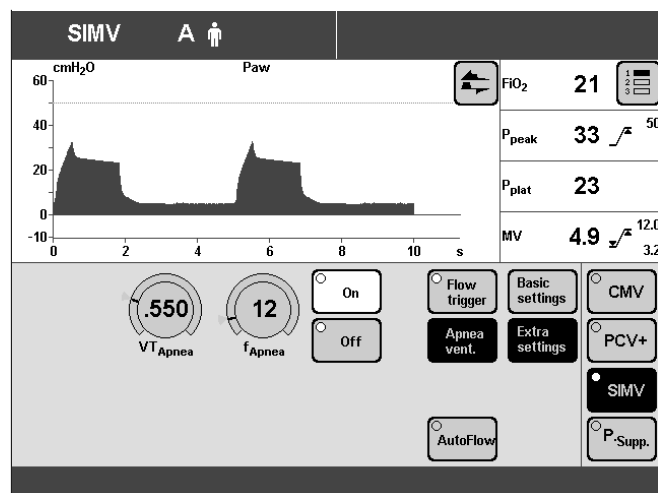


To set (Example: Apnea Ventilation)

- Touch »**Extra settings**« screen key.
- Touch screen key corresponding to the desired function, i.e. »**Apnea vent.**«.
- To switch function on, touch »**On**« screen key and press dial knob.
- To set values, touch corresponding screen knob, then turn and press dial knob.

SIMV and SIMV/P.Supp. can be configured with the additional ventilation parameter  $P_{\text{max}}$ .

For configuring » $P_{\text{max}}$  pressure limiting«, see page 129.



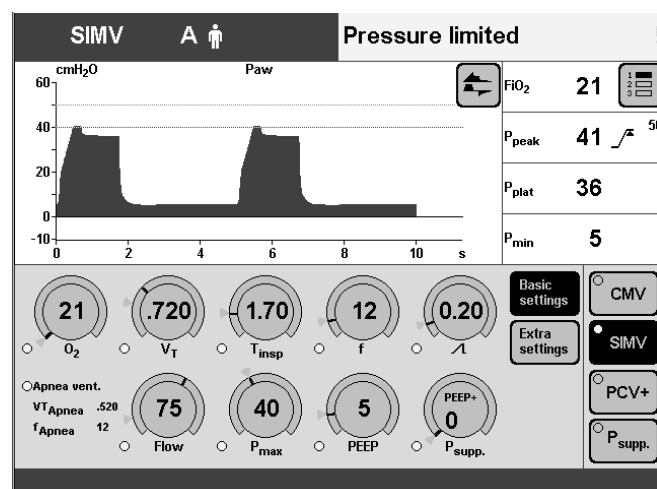
**Pressure Limited Ventilation (PLV)\*** – for manually limiting pressure peaks using the  $P_{\max}$  pressure limit. The tidal volume remains constant as long as the pressure waveform shows a plateau and the inspiratory flow waveform shows a brief flow pause between inspiration and expiration.

- Set pressure limit  $P_{\max}$ , see page 129.

The value for  $P_{\max}$  will appear as a dashed, blue line in the  $P_{aw}(t)$  waveform.

Volume monitoring is always active. A "Volume not constant" alarm is triggered automatically if the tidal volume  $V_T$  can no longer be delivered.

The visual and audible portion of the alarm can be muted with the »**Alarm Reset**« key until the cause for the alarm has been corrected.



\* For a detailed description of AutoFlow and PLV, see page 180.

**PCV+ (BIPAP), PCV+ (BIPAP)/P.Supp.**

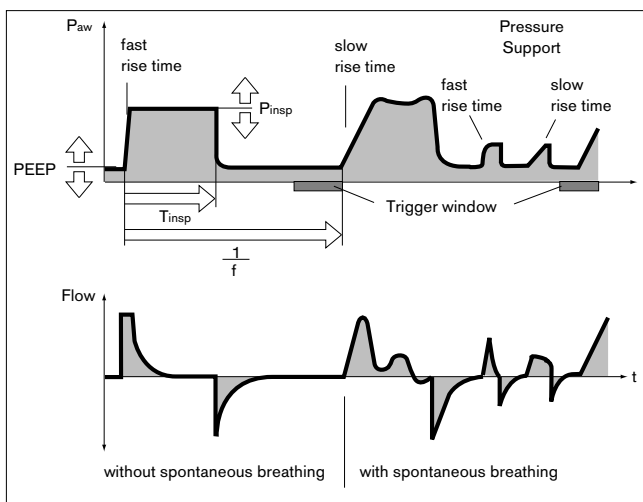
Pressure Controlled Ventilation Plus,  
Pressure Support

Pressure controlled ventilation combined with free spontaneous breathing at any time during the breathing cycle and adjustable pressure support at CPAP level. The mandatory portion of the total minute volume MV is set with inspiratory pressure  $P_{\text{insp}}$  and breath rate  $f$ .

Used for a range of patients from those unable to breathe spontaneously to those patients breathing spontaneously just before extubation. Weaning is accomplished by incrementally reducing the mandatory portion of the overall minute volume MV and reducing support pressure  $P_{\text{supp}}$ .

In the course of the weaning process, the ventilator rate may be reduced down to 0. The ventilator will then automatically switch to CPAP or CPAP/P.Supp. ventilation mode and it will also indicate this new ventilation mode.

**NOTE:** The »PCV+« screen key and the screen knobs for PCV+ (BIPAP) ventilation parameters will continue to be displayed.



Set the ventilation pattern for PCV+ (BIPAP) and PCV+ (BIPAP)/P.Supp. with the ventilation parameters:

Inspiratory pressure » $P_{\text{insp}}$ «

Breath rate » $f$ «

Inspiratory time » $T_{\text{insp}}$ «

O<sub>2</sub> concentration » $O_2$ «

Positive end-expiratory pressure »**PEEP**«

Pressure support » $P_{\text{supp}}$ «

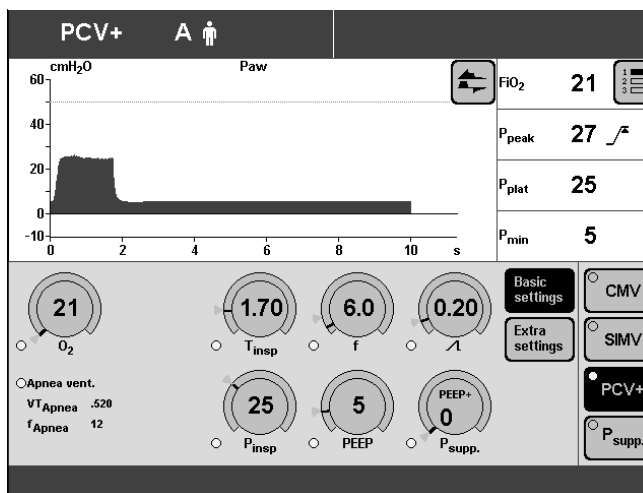
Pressure rise time »  $\nearrow$  «

Inspiratory pressure » $P_{\text{insp}}$ « can be reduced down to PEEP-level. The ventilation pattern then equals CPAP and CPAP/P.Supp., respectively.

Inspiratory pressure » $P_{\text{insp}}$ « is set as an absolute value, Pressure support » $P_{\text{supp}}$ « is set relative to the PEEP level.

To set:

- Touch the respective screen knob.
- Turn dial knob to set value.
- Press dial knob to confirm value.





PCV+ (BIPAP) and PCV+ (BIPAP)/P.Supp. may be configured with the following ventilation parameters:

**Flow trigger** – for synchronization with a patient's spontaneous breathing efforts.

Switching on flow trigger and setting a trigger level will synchronize mandatory breaths with the patient's spontaneous breaths.

A patient's spontaneous breathing efforts are indicated by briefly displaying a lung symbol in place of the patient mode symbol.

**Apnea ventilation** – for automatic switch to volume controlled mandatory ventilation if the patient stops breathing.

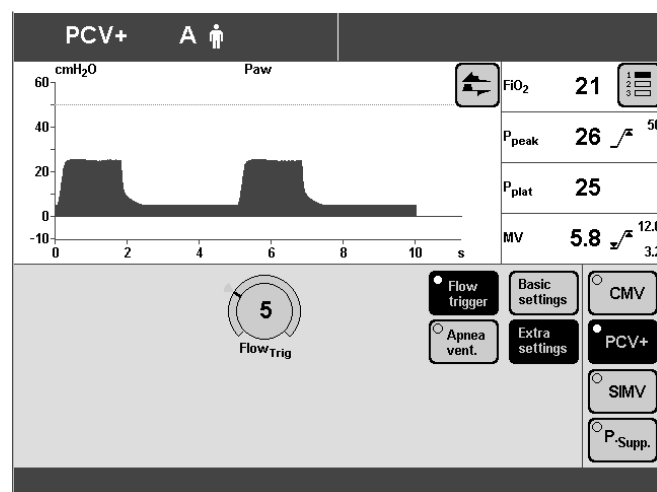
If breathing stops, Evita 4 will trigger an alarm after the set alarm time ( $T_{Apnea}$ ) and will start volume controlled ventilation with the set ventilation parameters:

Breath rate »**fApnea**«

Tidal volume »**VTApnea**«

To set (Example: Flow trigger)

- Touch »**Extra settings**« screen key.
- Touch »**Flow trigger**« screen key.
- To set value, touch »**Flow<sub>Trig</sub>**« screen knob, then turn and press dial knob.



### PCV<sup>+</sup>Assist (BIPAPAssist)

Pressure Controlled Ventilation Plus, Assisted

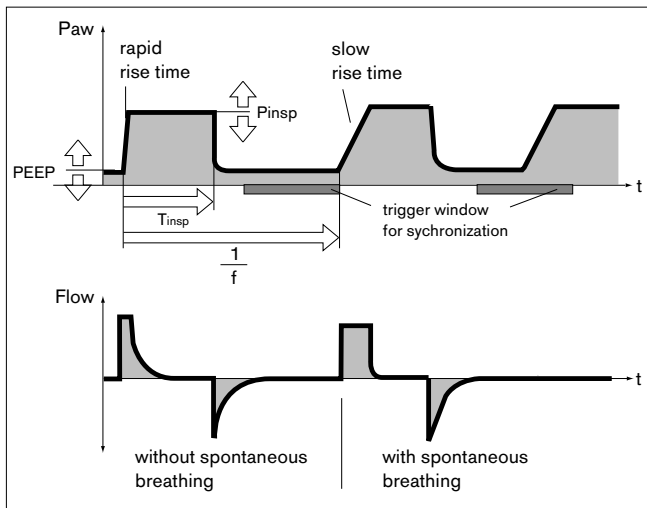
Pressure controlled, assisted ventilation

Delivered breaths are equivalent to those of PCV<sup>+</sup>. However, the switch from P<sub>insp</sub> to PEEP pressure is not synchronized with patient expiration. Spontaneous breathing may occur at anytime at the upper pressure level.

Each detected spontaneous inspiratory patient effort at PEEP pressure level will trigger a synchronized ventilator breath.

The ventilator will deliver an (unsynchronized) breath at the latest after the time defined by »f« has elapsed.

Used for patients without spontaneous breathing all the way to spontaneously breathing patients just before extubation.



Set the ventilation pattern for PCV<sup>+</sup>Assist (BIPAPAssist) with the ventilation parameters:

Inspiratory pressure »P<sub>insp</sub>«

Breath rate »f«

Inspiratory time »T<sub>insp</sub>«

O<sub>2</sub> concentration »O<sub>2</sub>«

Positive end-expiratory pressure »PEEP«

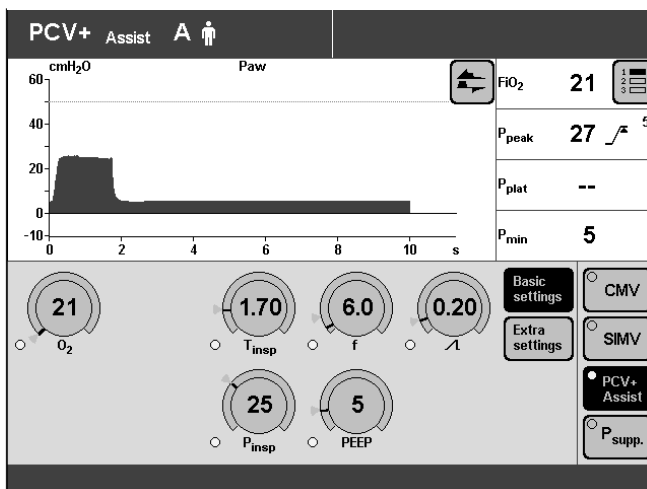
Pressure rise time » $\Delta$ «

Flow trigger »Flow<sub>Trig</sub>«

Inspiratory pressure »P<sub>insp</sub>« is set in absolute terms.

To set:

- Touch respective screen key.
- Turn dial knob to set value.
- Press dial knob to confirm value.



**CPAP, CPAP/P.Supp.**

Continuous Positive Airway Pressure  
Pressure Support

Spontaneous breathing at a raised pressure level in order to increase the functional residual capacity (FRC). Spontaneous breathing can be augmented with additional pressure via pressure support.

Used for patients breathing spontaneously.

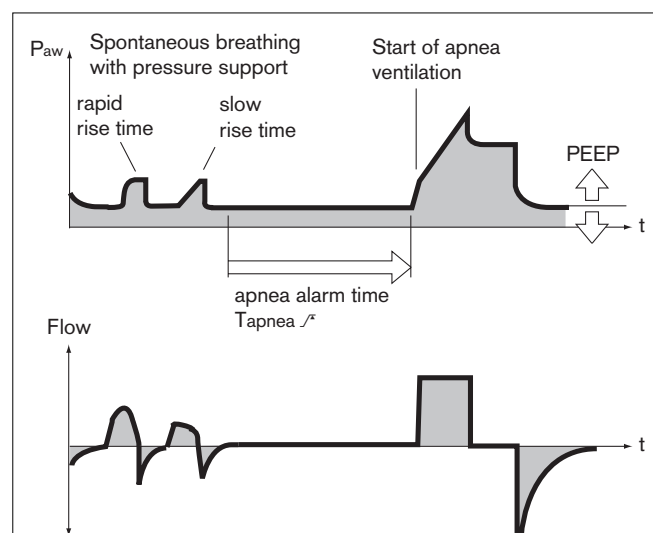
Set the ventilation pattern for CPAP and CPAP/P.Supp. with the following ventilation parameters:

O<sub>2</sub> concentration »O<sub>2</sub>«

Positive end-expiratory pressure »PEEP«

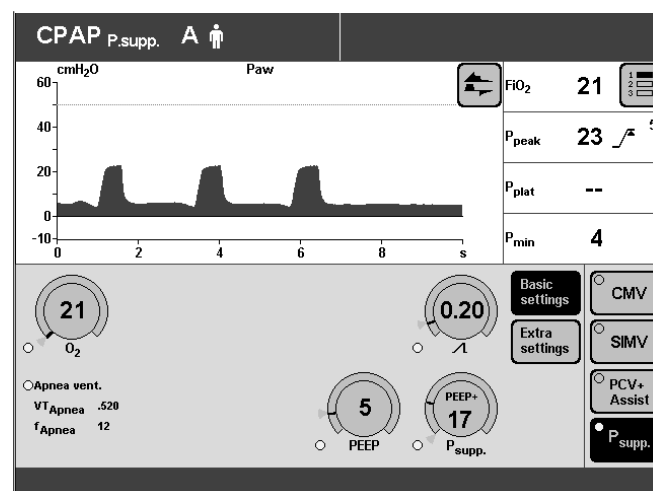
Support pressure »P<sub>supp.</sub>«

Pressure rise time » $\nearrow$ «



To set:

- Touch the respective screen key.
- Turn dial knob to set value.
- Press dial knob to confirm value.



CPAP and CPAP/P.Supp. can be extended with the following ventilation parameters:

**Flow trigger** – for synchronization with a patient's spontaneous breathing efforts.

Switching on flow trigger and setting a trigger level will synchronize mandatory breaths with the patient's spontaneous breaths.

A patient's spontaneous breathing efforts are indicated by briefly displaying a lung symbol in place of the patient mode symbol.

**Apnea ventilation** – for automatic switch to volume controlled mandatory ventilation if the patient stops breathing.

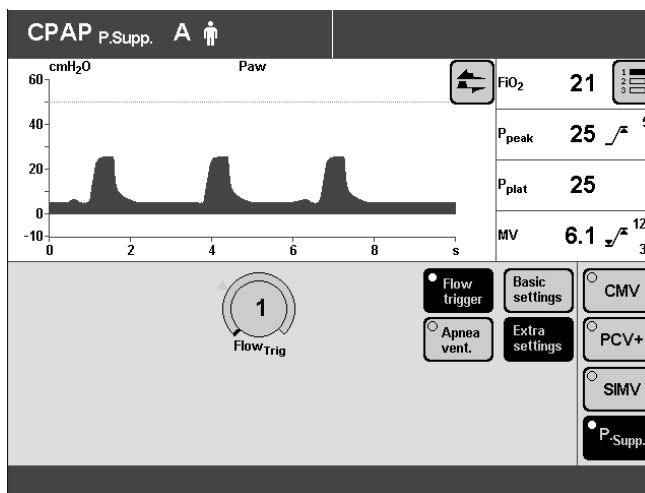
If breathing stops, Evita 4 will trigger an alarm after the set alarm time ( $T_{Apnea}$ ) and will start volume controlled ventilation with the set ventilation parameters:

Breath rate »fApnea«

Tidal volume »VTApnea«.

To set (Example: Flow trigger)

- Touch »**Extra settings**« screen key.
- Touch »**Flow trigger**« screen key.
- To set values, touch »**FlowTrig**« screen knob, then turn and press dial knob.



## MMV, MMV/P.Support.

### Mandatory Minute Volume Ventilation Pressure Support

The overall minute volume is preset to a mandatory level, which can be adjusted via tidal volume  $V_T$  and breath rate  $f$ .

The patient can breathe spontaneously, thereby contributing a portion of the overall minute volume. The difference between the spontaneously breathed minute volume and the set minute volume is provided by mandatory ventilator breaths. Spontaneous breathing can be augmented with pressure support.

This mode is intended for patients being weaned off the ventilator by incrementally reducing the mandatory portion of overall minute ventilation.

Set the ventilation pattern for MMV and MMV/P.Support. with the ventilation parameters:

Tidal volume »**VT**«

Insp. flow »**Flow**«

Breath rate »**f**«

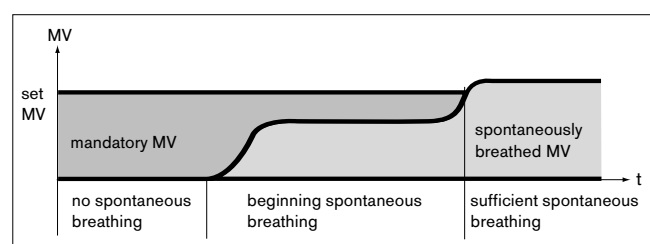
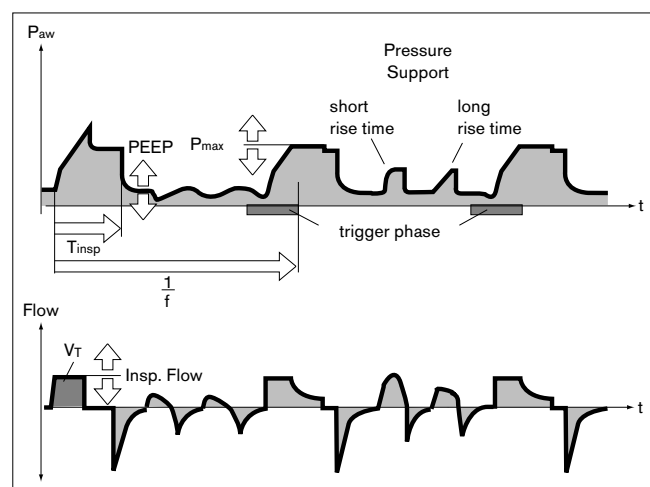
Inspiratory time »**T<sub>insp</sub>**«

O<sub>2</sub> concentration »**O<sub>2</sub>**«

Positive end-expiratory pressure »**PEEP**«

Support pressure »**P<sub>supp.</sub>**«

Pressure rise time »**∧**«



To set:

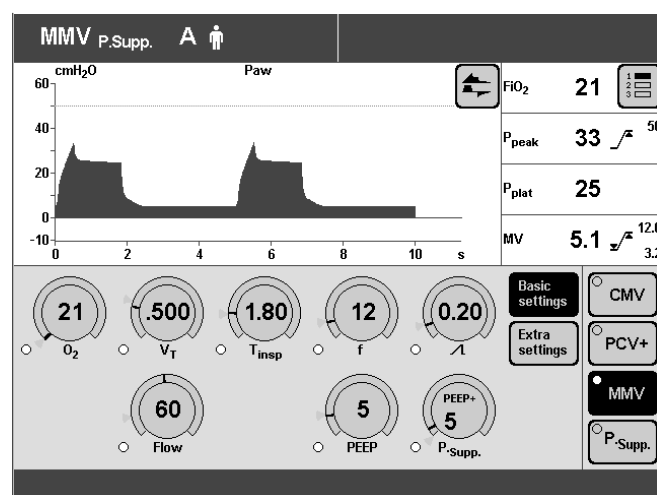
- Touch the respective screen key.
- Turn dial knob to set value.
- Press dial knob to confirm value.

MMV and MMV/P.Support. can be extended with the following ventilation parameters:

**Flow trigger** – for synchronization with a patient's spontaneous breathing efforts.

Switching on flow trigger and setting a trigger level will synchronize mandatory breaths with the patient's spontaneous breaths.

A patient's spontaneous breathing efforts are indicated by briefly displaying a lung symbol in place of the patient mode symbol.

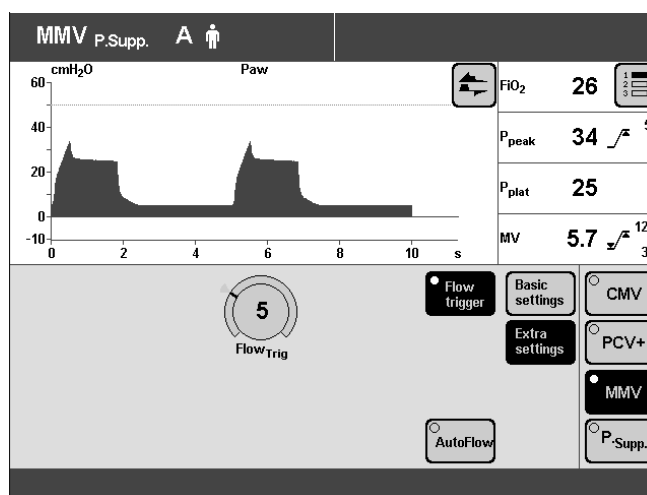


**AutoFlow®** – for automatically optimizing inspiratory flow. With AutoFlow\*, inspiratory flow is decelerated and controlled in such a way that the set tidal volume VT is delivered at a minimum airway pressure for a given patient lung compliance while avoiding pressure peaks. Evita 4 delivers additional inspiratory flow during spontaneous inspirations – limited by the alarm limit VTi  $\sqrt{}$ . The patient can also exhale during the inspiratory plateau. Inspiratory pressure is limited by the alarm limit for Paw  $\sqrt{}$ .

- Set alarm limits MV  $\sqrt{}$  and MV  $\sqrt{}$  to avoid over- or under-ventilating a patient with a rapidly changing compliance.

To set (Example: Flow trigger)

- Touch »Extra settings« screen key.
- Touch »Flow trigger« screen key.
- To set value, touch »FlowTrig« screen knob, then turn and press dial knob.



MMV and MMV/P.Supp. can be configured with the additional ventilation parameter P<sub>max</sub>. For selecting »P<sub>max</sub> pressure limiting«, see page 129.

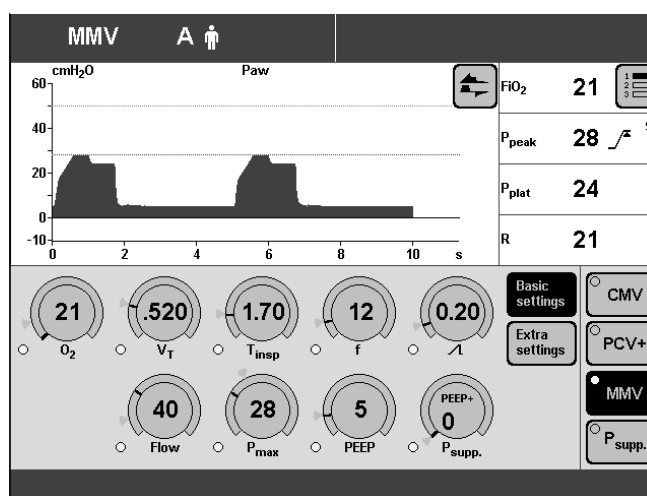
**Pressure Limited Ventilation (PLV)\*** – for manually limiting pressure peaks using the P<sub>max</sub> pressure limit. The tidal volume remains constant as long as the pressure waveform shows a plateau and the inspiratory flow waveform shows a brief flow pause between inspiration and expiration.

- Set pressure limit P<sub>max</sub>, see page 129.

The value for P<sub>max</sub> will appear as a dashed, blue line in the Paw(t) waveform.

Volume monitoring is always active. A "Volume not constant" alarm is triggered automatically if the tidal volume VT can no longer be delivered.

The visual and audible portion of the alarm can be muted with the »Alarm Reset« key until the cause for the alarm has been corrected.



\* For a detailed description of AutoFlow and PLV, see page 180.

## APRV

### Airway Pressure Release Ventilation

Free spontaneous breathing at a raised CPAP pressure level together with a short period of low pressure (Release).

This mode is intended for patients who are breathing spontaneously but who need assistance with CO<sub>2</sub> removal.

Set the ventilation pattern for APRV with the ventilation parameters:

Inspiratory time »**T<sub>high</sub>**«

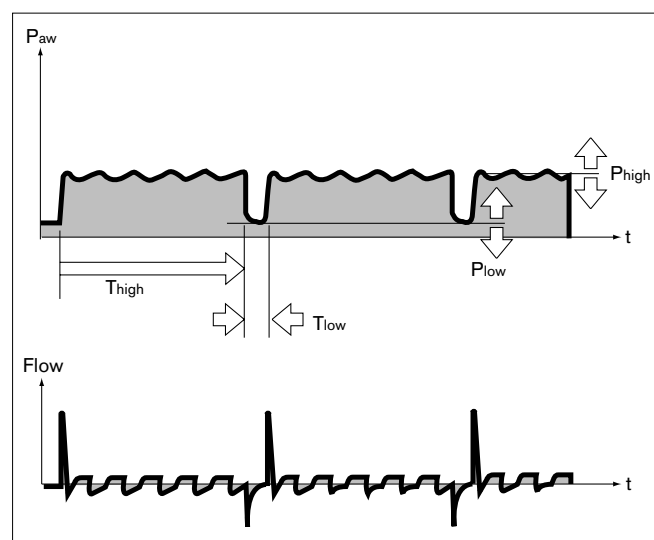
Expiratory time »**T<sub>low</sub>**«

Inspiratory pressure »**P<sub>high</sub>**«

Positive end-expiratory pressure »**P<sub>low</sub>**«

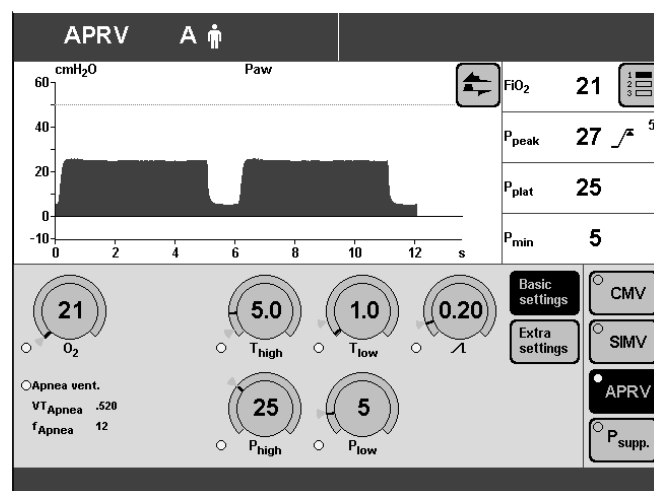
O<sub>2</sub>-concentration »**O<sub>2</sub>**«

Pressure rise time »**∧**«



To set:

- Touch the respective screen knob.
- Turn dial knob to set value.
- Press dial knob to confirm value.



APRV can be extended with the following ventilation parameters:

**Apnea Ventilation** – for automatic switch to volume controlled mandatory ventilation if the patient stops breathing.

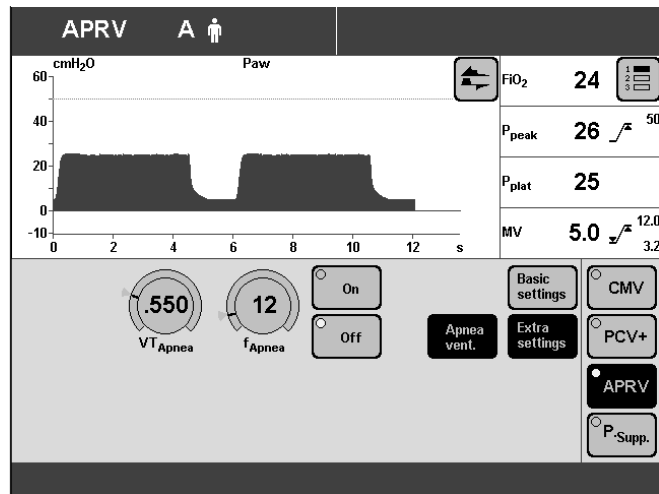
If breathing stops, Evita 4 will trigger an alarm after the set alarm time ( $T_{\text{apnea}} \sqrt{\text{r}}$ ) and will start volume controlled ventilation with the set ventilation parameters:

Breath rate »**f<sub>Apnea</sub>**«

Tidal volume »**VT<sub>Apnea</sub>**«

To set (Example: Apnea ventilation)

- Touch »**Extra settings**« screen key.
- Touch »**Apnea vent.**« screen key.
- To switch function on, touch »**On**« screen key and press dial knob.
- To set values, touch corresponding screen knob, then turn and press dial knob.





## Independent Lung Ventilation (ILV)

Synchronized, independent ventilation of the two lung sides with two Evita ventilators that are connected via analog interface.

The two ventilators are operated in master/slave mode with the master ventilator controlling ventilation.

### Preparation for ILV

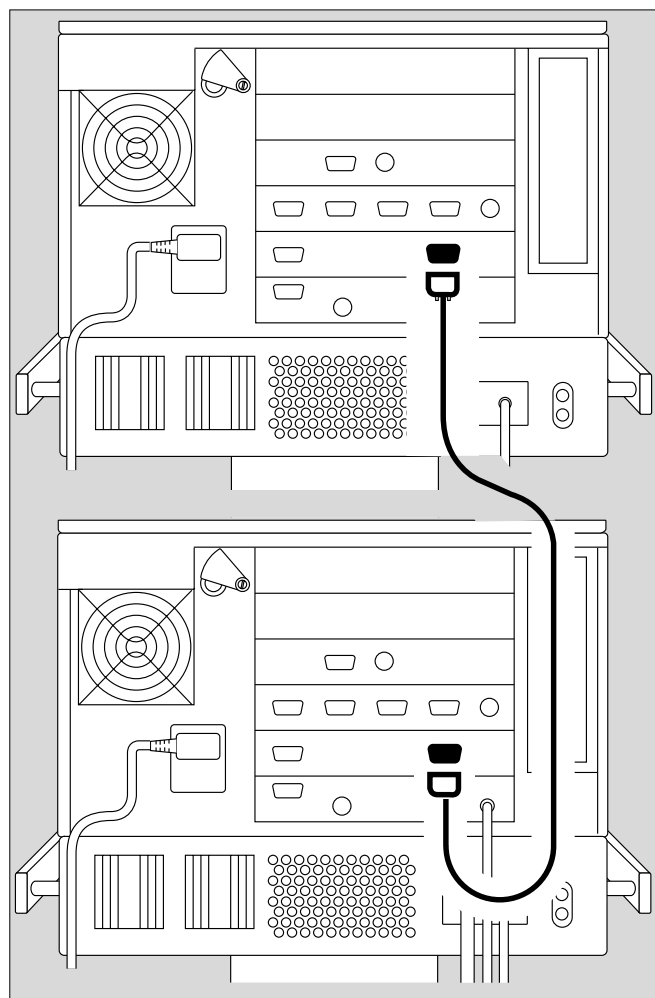
The following device combinations are supported:

- combination of two Evita 4
- combination of Evita 4 and Evita 2 dura.

Prerequisite for both combinations:

Interface cable part no. 84 11 794 for connecting Evita 4 to a second Evita 4 or a Evita 2 dura, respectively.

- Connect the two ventilators through their ILV sockets using interface cable part no. 84 11 794 (required).



## Settings for Master and Slave Ventilator

For independent lung ventilation:

- Prepare one ventilator for ILV/Master mode and
- prepare the other ventilator for ILV/Slave mode.
- Set parameters, see page 30.

**NOTE:** Activate ILV mode only after all parameters for ILV/Master and ILV/Slave ventilators have been adjusted.

### Settings for ILV/Master ventilation mode

Volume controlled ventilation with fixed mandatory minute volume MV, adjusted via tidal volume VT and ventilator rate f.

For patients without spontaneous breathing for independent lung ventilation.

Set ILV/Master ventilation pattern with the parameters:

Tidal volume »VT«

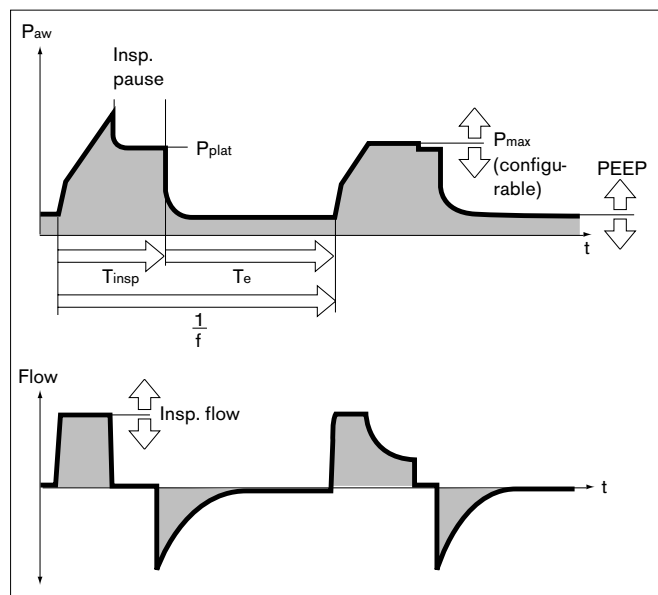
Insp. Flow »Flow«

Breath rate »f«

Inspiratory time »T<sub>insp</sub>«

O<sub>2</sub> concentration »O<sub>2</sub>«

Positive end-expiratory pressure »PEEP«



To set:

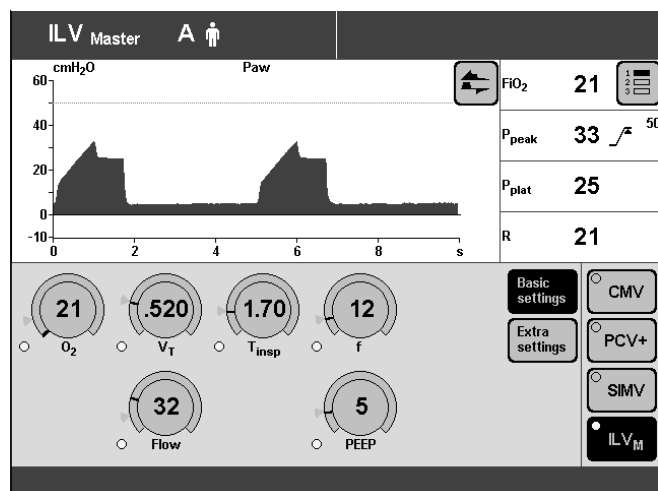
- Touch the respective screen knob.
- Turn dial knob to set value.
- Press dial knob to confirm value.

ILV/Master can be extended with the following ventilation parameters:

**Flow trigger** (ILV/Master Assist) – for synchronization with a patient's spontaneous breathing efforts.

Switching on flow trigger and setting a trigger level will synchronize mandatory breaths with the patient's spontaneous breaths.

A patient's spontaneous breathing efforts are indicated by briefly displaying a lung symbol in place of the patient mode symbol.



**Intermittent PEEP** – for prophylactic treatment of atelectasis.

Switching on and setting an intermittent PEEP may help prevent atelectasis.

Intermittent PEEP, when activated, will increase end-expiratory pressure for two ventilator breaths every 3 minutes by the value set for intermittent PEEP.

ILV/Master may also be configured with the additional ventilation parameter  $P_{\max}$  for pressure limited ventilation. For configuring » $P_{\max}$  pressure limiting«, see page 129.

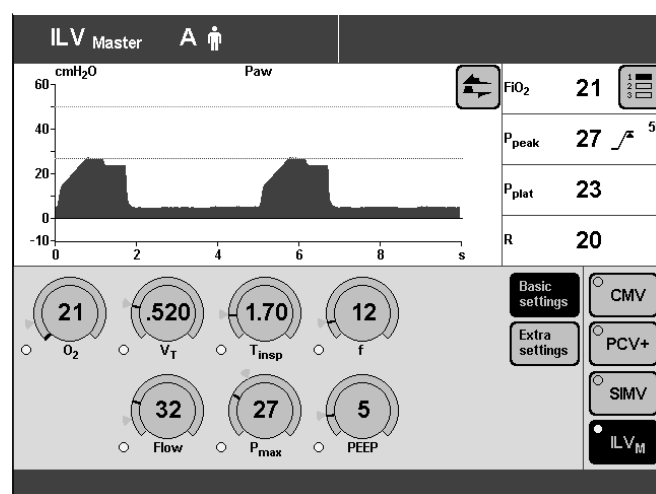
**Pressure Limited Ventilation (PLV)** – for manually limiting pressure peaks using the  $P_{\max}$  pressure limit. The tidal volume remains constant as long as the pressure waveform shows a plateau and the inspiratory flow waveform shows a brief flow pause between inspiration and expiration.

- Set pressure limit  $P_{\max}$ , see page 129.

The value for  $P_{\max}$  will appear as a dashed, blue line in the  $P_{aw}(t)$  waveform.

Volume monitoring is always active. A "Volume not constant" alarm is triggered automatically if the tidal volume  $V_T$  can no longer be delivered.

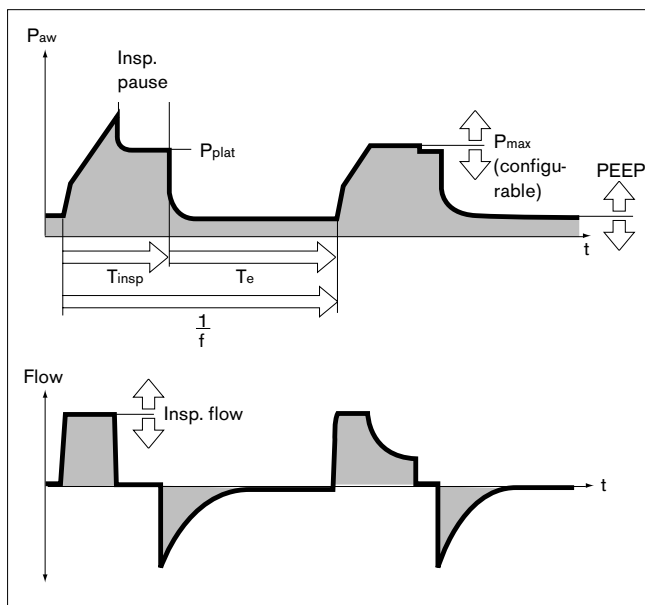
The visual and audible portion of the alarm can be muted with the »**Alarm Reset**« key until the cause for the alarm has been corrected.



### Settings for ILV/Slave ventilation mode

Volume controlled ventilation with fixed mandatory minute volume MV, adjusted via tidal volume VT and breathing rate f of the ILV master ventilator, and selectable slave mode.

For patients without spontaneous breathing for independent lung ventilation.

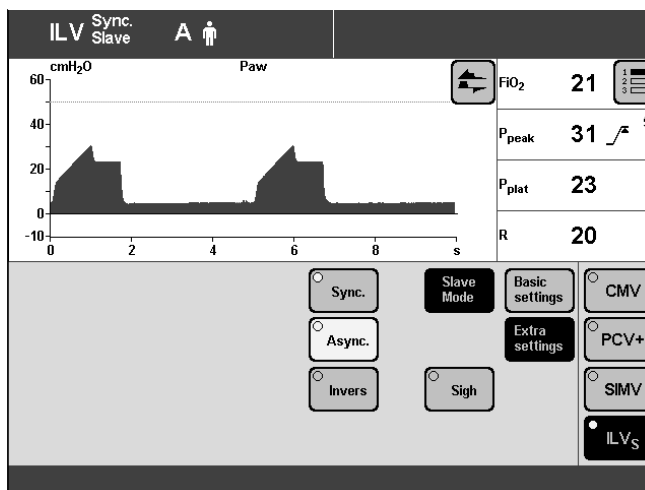


To set slave mode:

- Touch »**Extra settings**« screen key.
- Touch »**Slave Mode**« screen key.

Select desired slave mode (e.g. »**Async.**«)

- Touch respective screen key and press dial knob.



## ILV: Master/Slave Synchronization

### Master ventilator:

I:E ratio

### Slave ventilator:

**Sync.** - The I:E ratio for the slave ventilator is obtained from the I:E ratio of the master ventilator. Inspirations begin synchronized with the inspirations of the master ventilator.

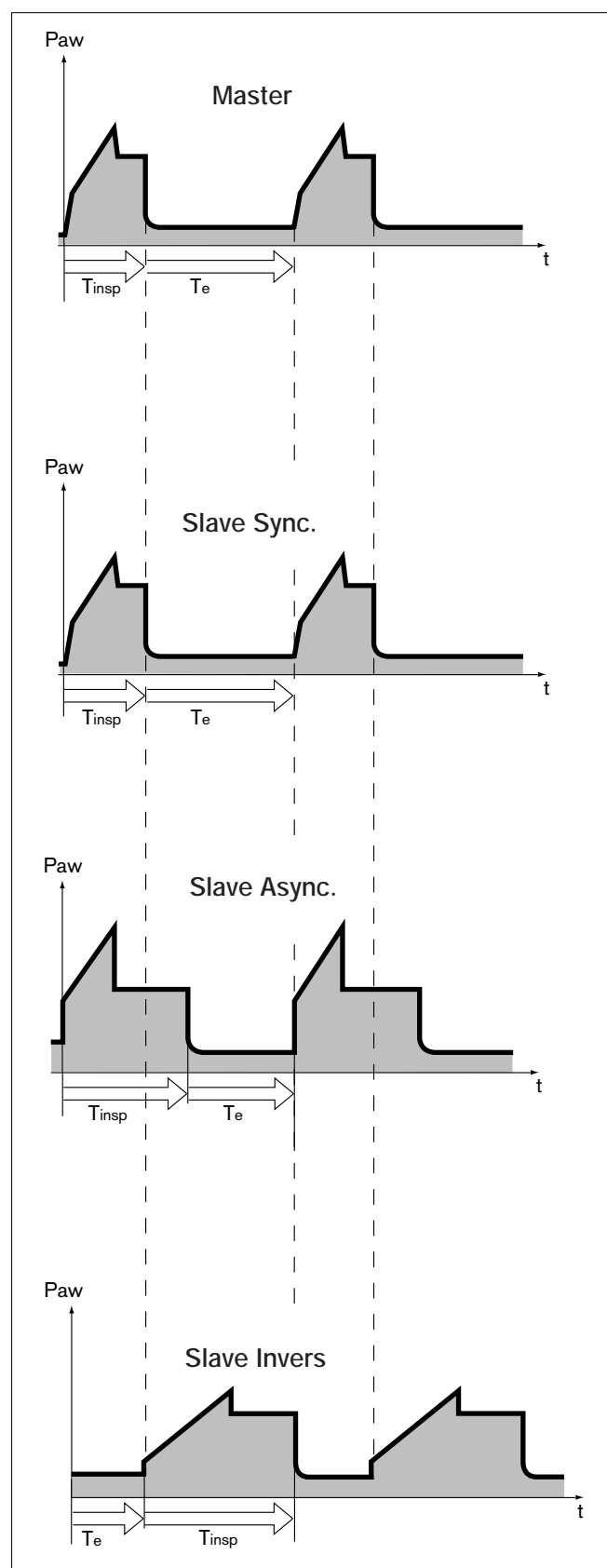
### Slave ventilator:

**Async.** - Inspirations begin synchronized with the inspirations of the master ventilator.

End of inspiration (including any inspiratory pause) results from the value set for »**T<sub>insp</sub>**«. The I:E ratio of the slave ventilator may be adjusted independently.

### Slave ventilator:

**Inverse** - Inspirations begin synchronized with the expiration of the master ventilator and vice versa. The I:E ratio of the slave ventilator is the inverse of that of the master ventilator.



Set ILV/Slave ventilation pattern with the parameters:

Tidal volume »**VT**«

Insp. Flow »**Flow**«

Breath rate »**f**«

Inspiratory time »**T<sub>insp</sub>**«

O<sub>2</sub> concentration »**O<sub>2</sub>**«

Positive end-expiratory pressure »**PEEP**«

To set:

- Touch the respective screen knob.
- Turn dial knob to set value.
- Press dial knob to confirm value.

The setting of »**f**« is not immediately active.

In order to prevent that both lung compartments are ventilated at different rates in case of an inadvertent separation of the two ventilators:

Set »**f**« on slave ventilator to same value as on master ventilator as a safety setting!

In "Async." slave mode, the setting of »**T<sub>insp</sub>**« is effective immediately.

In modes "Sync." and "Inverse" this setting goes into effect only in case of an inadvertent separation of the two ventilators.

ILV/Master can be extended with the following ventilation parameters:

**Intermittent PEEP** – for prophylactic treatment of atelectasis.

Switching on and setting an intermittent PEEP may help prevent atelectasis.

Intermittent PEEP, when activated, will increase end-expiratory pressure for two ventilator breaths every 3 minutes by the value set for intermittent PEEP.

ILV/Master may also be configured with the additional ventilation parameter P<sub>max</sub> for pressure limited ventilation. For configuring »P<sub>max</sub> pressure limiting«, see page 129.

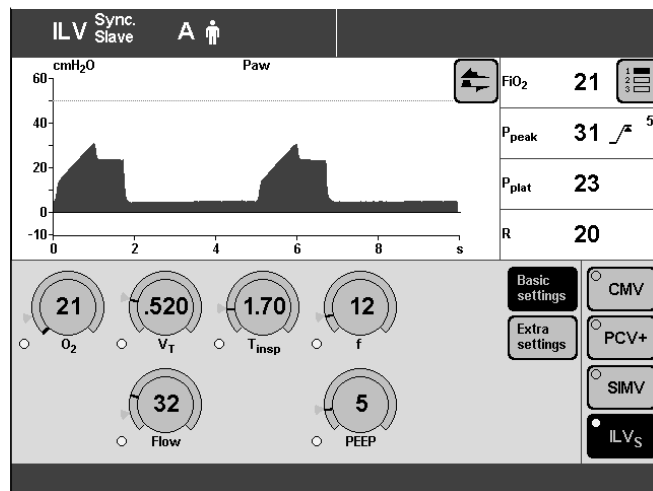
**Pressure Limited Ventilation (PLV)** – for manually limiting pressure peaks using the P<sub>max</sub> pressure limit. The tidal volume remains constant as long as the pressure waveform shows a plateau and the inspiratory flow waveform shows a brief flow pause between inspiration and expiration.

- Set pressure limit P<sub>max</sub>, see page 129.

The value for P<sub>max</sub> will appear as a dashed, blue line in the P<sub>aw</sub>(t) waveform.

Volume monitoring is always active. A "Volume not constant" alarm is triggered automatically if the tidal volume VT can no longer be delivered.

The visual and audible portion of the alarm can be muted with the »**Alarm Reset**« key until the cause for the alarm has been corrected.



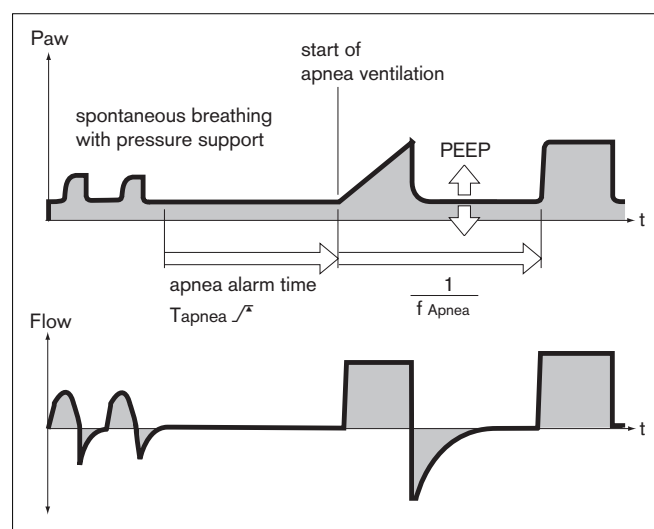
## Apnea Ventilation

Provides automatic switch to volume controlled, mandatory ventilation if the patient stops breathing. Apnea ventilation can be switched on in the ventilation modes SIMV, PCV+ (BIPAP), CPAP, APRV. Evita 4 generates an apnea alarm if, during the set apnea time »T<sub>Apnea</sub>«, no expiratory flow was measured and/or no sufficient inspiratory gas delivery was performed. If breathing stops, Evita 4 will trigger an alarm after the set alarm delay time (T<sub>Apnea</sub> /<sup>2</sup>) and will start volume controlled ventilation with the set ventilation parameters: Breath rate »f<sub>Apnea</sub>«  
Tidal volume: »VT<sub>Apnea</sub>«

Ventilation parameters »O<sub>2</sub>« and »PEEP« will correspond to the settings effective at the time.

Inspiratory time for apnea ventilation is determined from the set breath rate »f<sub>Apnea</sub>« and a fixed I:E ratio of 1:2.

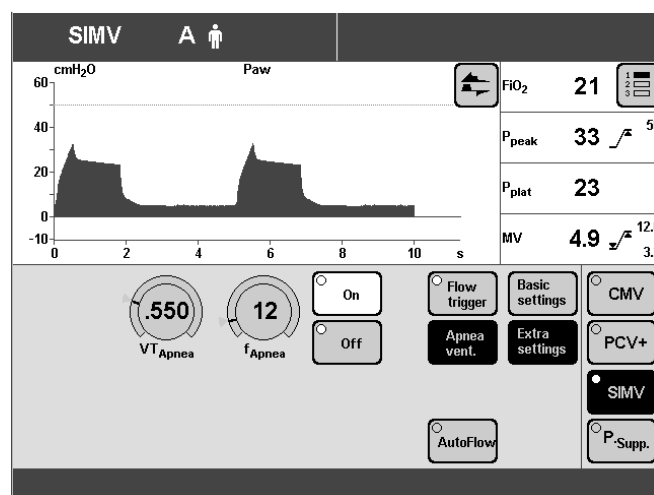
Just as in SIMV, the patient is allowed to breathe spontaneously during apnea ventilation, and mandatory breaths are synchronized with the patient's spontaneous breathing. The breath rate during apnea ventilation remains constant under these circumstances.



To set:

- Touch »Extra settings« screen key.
- Touch »Apnea vent.« screen key.
- To switch function on, touch »On« screen key and press dial knob.
- To set value, touch corresponding screen knob, then turn and press dial knob.

**NOTE:** Evita 4 will show status and settings for apnea ventilation on the "Settings" screen page.



To terminate apnea ventilation:

- Press the »Alarm Reset« key: the ventilator will continue operating in its previous ventilation mode or
- select another ventilation mode.

Apnea ventilation On/Off, see page 131.

## Setting Alarm Limits

- Press »Limits« key.


Display screen »Limits« (example):

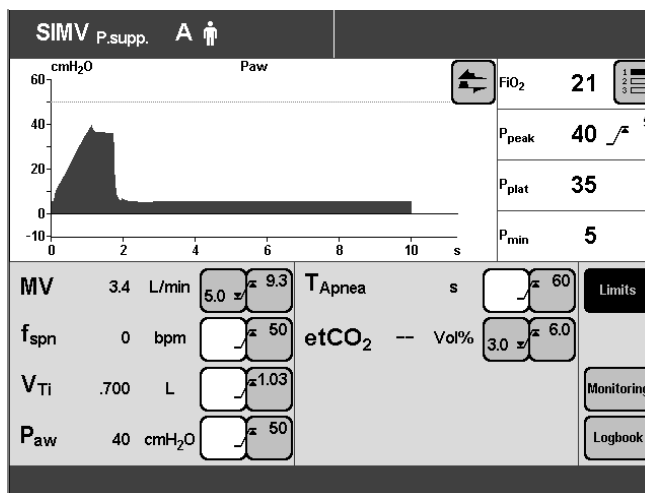
This page displays all the adjustable alarm limits.

↙ = lower alarm limit

↗ = upper alarm limit

Example: Lower alarm limit for minute volume MV.

- Touch screen key »« for MV: the key changes color from green to yellow.
- Set the alarm limit and confirm by turning and pressing the dial knob. The new alarm limit will now be effective.



No lower alarm limit needs to be set for airway pressure Paw, it is automatically linked to the PEEP setting.

No alarm limits needs to be set for O2 concentration. These limits are automatically linked to the setting of O2 concentration.

Lower alarm limit:







Setting – 4 Vol.% (for settings up to 60 Vol.%)

Setting – 6 Vol.% (for settings from 60 to 100 Vol.%)

Upper alarm limit:

Setting + 4 Vol.% (for settings up to 60 Vol.%)

Setting + 6 Vol.% (for settings from 60 to 100 Vol.%)

Ventilation Parameter	Adjustment Range
MV 	0.1 to 41 L/min 0.01 to 40 L/min
fspont 	5 to 120 bpm No lower alarm limit
VTi 	0.021 to 4 L No lower alarm limit
Paw 	10 to 100 cmH2O no adjustable lower alarm limit
etCO2 	0 to 100 mmHg, 0.1 to 15 kPa 0 to 99 mmHg, 0 to 14.9 kPa
Tapnea 	5 to 60 seconds No lower alarm limit



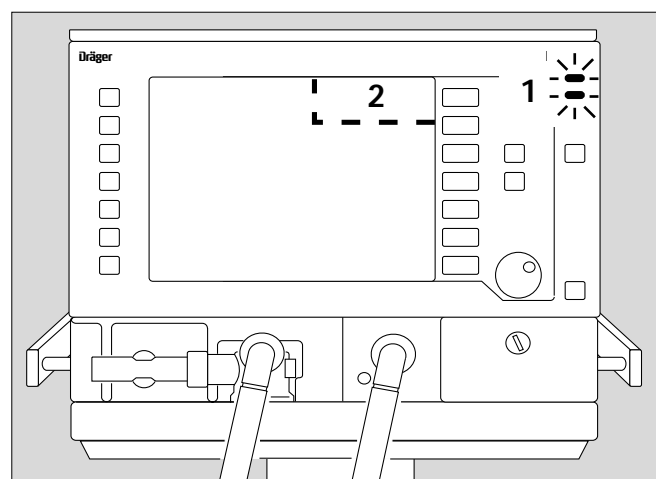
## In the Event of an Alarm

- 1 The red or yellow light will flash.
- 2 An alarm message will be displayed in the top right-hand corner of the screen.

Evita 4 determines the priority of the alarm message, marks the text with exclamation marks as well as colored backgrounds, and generates the different audible alarm sequences.

### WARNING !

**Warning or Caution level audible alarms require immediate operator attention to avert or to prevent development of situations with the possibility of patient injury.**



### Warning = top priority message

The red light flashes.

Warning messages are marked with three (3) exclamation marks.

Example: **Apnea !!!**

Warning messages are displayed against a red background.

The corresponding audible alarm is a 5-tone sequence that sounds twice and is repeated every 7 seconds.

### Caution = medium priority message

The yellow light flashes.

Caution messages are marked with two (2) exclamation marks.

Example: **O<sub>2</sub> pressure high !!**

Caution messages are displayed against a yellow background.

The corresponding audible alarm is a 3-tone sequence that is repeated every 20 seconds.

### Advisory = low priority message

The yellow light remains constantly lit.

Advisory messages are marked with one exclamation mark.

Example: **Fan malfunction !**

Advisory messages are displayed against a yellow background.

The corresponding audible alarm is a 2-tone sequence that sounds only once.

If the loudspeaker for audible alarms fails on account of a defect, an auxiliary signal will sound continuously. This continuous tone also serves as power failure alarm, see page 52, if power is interrupted while the ventilator is in use.

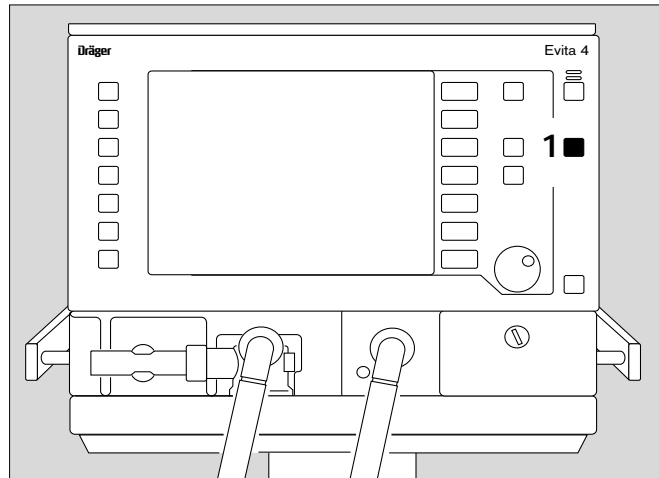
To remedy any faults, please refer to the "Troubleshooting" section, starting on page 156.

Once a fault condition has been remedied, the audible alarm will be switched off. Caution and Advisory messages will disappear automatically.

Warning messages (!!!) will then appear in the regular color of the status field and must be acknowledged:

- 1 Press »**Alarm Reset**« key.

The message is erased from the screen. However, it is stored in the ventilator and can be called on screen again with the logbook function in the »Measured Values« screen page, see page 96.

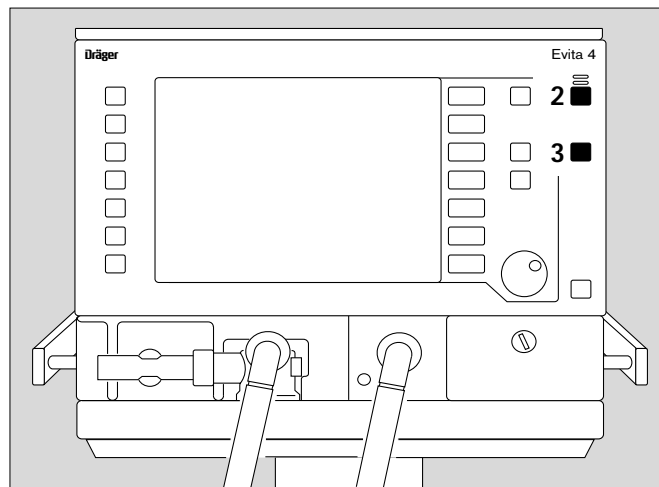


## Silencing Audible Alarms

for max. 2 minutes:

- 2 Press the »**Alarm Silence**« key, the yellow indicator LED will be lit. The audible alarm will be silenced for 2 minutes. If the fault that triggered the alarm persists, the audible alarm will start again after that time.  
If you wish to reactivate the audible alarm temporarily:

- 2 Press the »**Alarm Silence**« key, the yellow LED will be switched off.



### WARNING !

The alarm silence key is intended to provide a way of muting audible alarms while corrective action is taken. The operator of the ventilator must still assume responsibility for proper ventilation and patient safety in the event of an alarm. Failure to identify and correct alarm situations may result in patient injury

To acknowledge an alarm:

- 3 Press »**Alarm Reset**« to reset alarm messages that are resettable. See also "Troubleshooting, page 156.

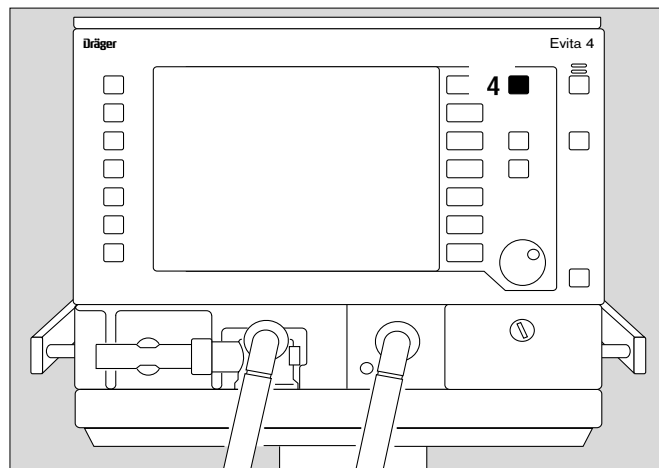
## Information i

- For help with operating the ventilator system – providing on-screen setting instructions.
- For help with troubleshooting.

- 4 Press »**i**« key: information is displayed in the bottom line of the screen.

To cancel on-screen help:

- 4 Press »**i**« key again.



## Displaying Waveforms and Measured Values

### In the standard page

- Press »Main Screen« key.

»Standard page« display:


In the right-hand field: 4 measured values

In the left-hand field: 2 waveforms

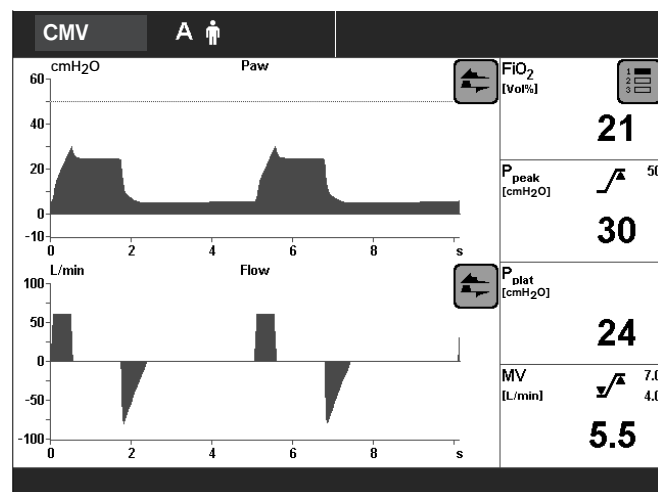
To select one of three measured value combinations:

- Touch »« screen key repeatedly.

To select other waveforms:

- Touch »« screen key, then touch the screen key of the waveform combination desired.

Measured values and waveforms can be preselected, see "Configuration", page 123 and 125, respectively.



### In all other screen pages

e.g. »Settings« page

- Press »Settings«.


»Settings« display:

Right-hand field: 4 measured values


(as in the standard page)

Left-hand field: 1 waveform.

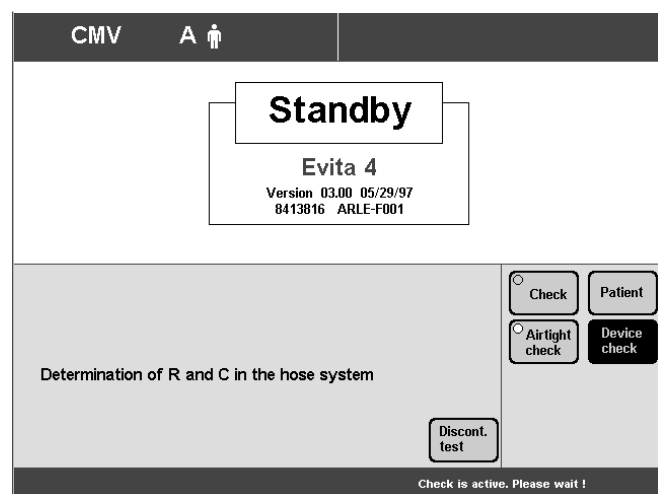
To select one of the three measured value combinations:

- Touch »« screen key repeatedly.

To select one of three other waveforms:

- Touch »« screen key, then touch the screen key of the waveform combination desired.

Measured values and waveforms can be preselected, see "Configuration", page 123 and 125, respectively.

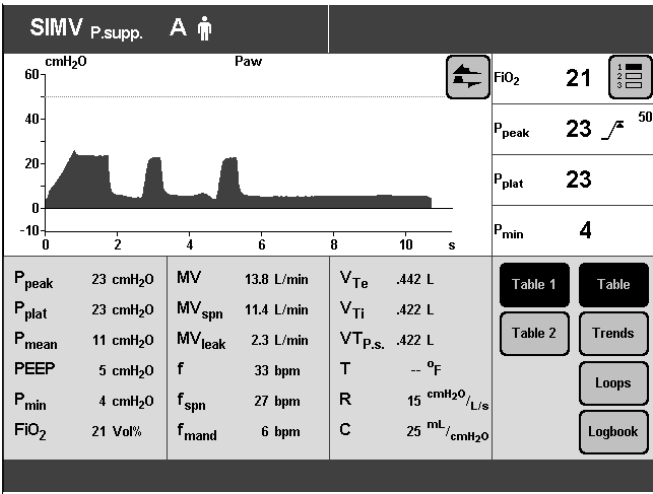


Displaying Measured Values

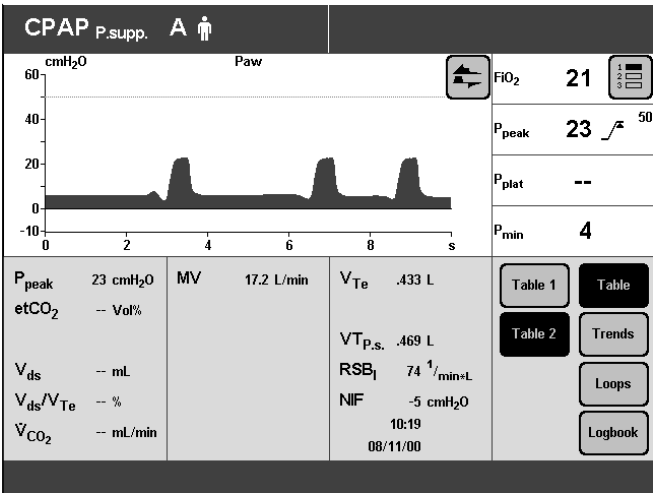
- Press the »Values measured« key.

Display »Table 1«:

Evita measured values and their measurement units are displayed in table format. Values measured are grouped in »Table 1« and »Table 2«.



Display »Table 2«  
rendering the optional parameters:  
VTP.Support., inspiratory tidal volume during a pressue support breath  
RSB, Rapid Shallow Breathing index<sup>1)</sup>  
NIF, Negative Inspiratory Force index<sup>2)</sup>



1) For a detailed description of RSB, see "Theory of Operation" page 194.  
2) For a detailed description of NIF, see "Theory of Operation" page 194.  
Application of NIF, see " Manually Timed Expiration, page 101

## Trends

- Touch »**Trends**« screen key.

»**Trend**« display:

The trend of two measured values is displayed.

To widen the time window (zooming out):

- Touch »**Zoom out**« screen key.


To narrow the time window (zooming in):

- Touch »**Zoom in**« screen key.

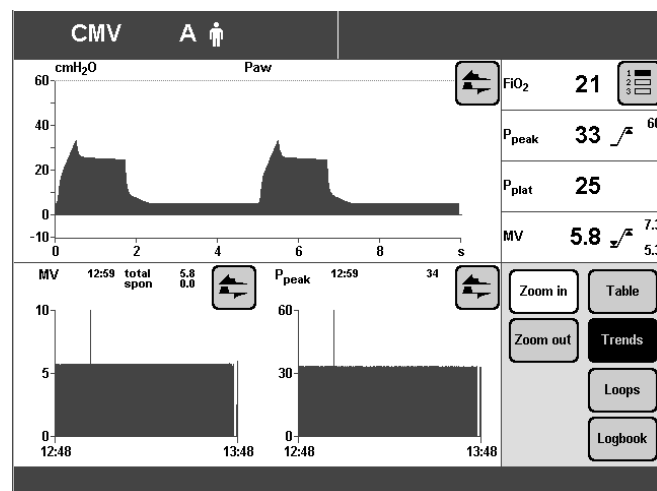
To evaluate measured values at a particular point in time:

- Position hairline cursor to the desired time by turning the dial knob.  
Time and associated measured value are displayed above the trend display.

To display another preconfigured trend of measured values:

- Touch »  « screen key, then touch the respective screen key.

To preselect measured values for the trend display, please refer to "Configuration", page 126.




## Loops

- Touch »**Loops**« screen key.

»**Loop**« display:

Two pairs of parameters plotted against each other appear as a loop for each ventilation cycle, e.g. the PV loop.

To select a different preconfigured parameter pair as a loop:

- Touch »  « screen key displayed in the "Loop" area of the display.

### Reference loop overlay

For permanently displaying a loop from a particular breathing cycle as a reference for current loops.

Date and time of the reference are inserted into the screen display.

- Touch »**Reference**« screen key.

Date and time of the reference loop appear below the »**Reference**« screen key\*.

### Single breath display

For displaying a single breath when operating in ventilation modes that include both ventilator and patient breaths, e.g. SIMV.

- Touch »**Single breath**« screen key.

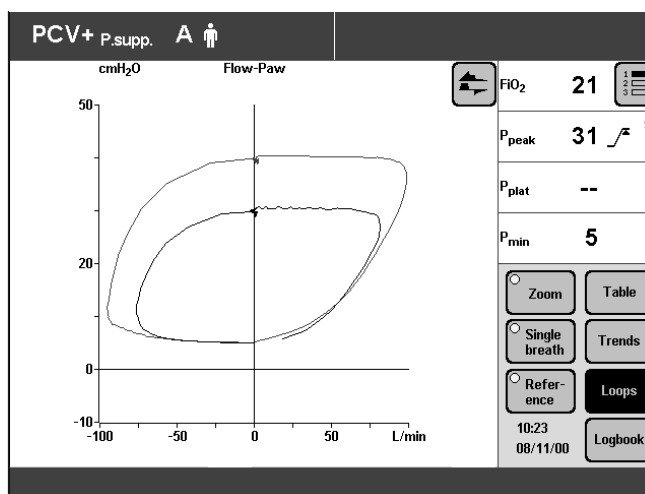
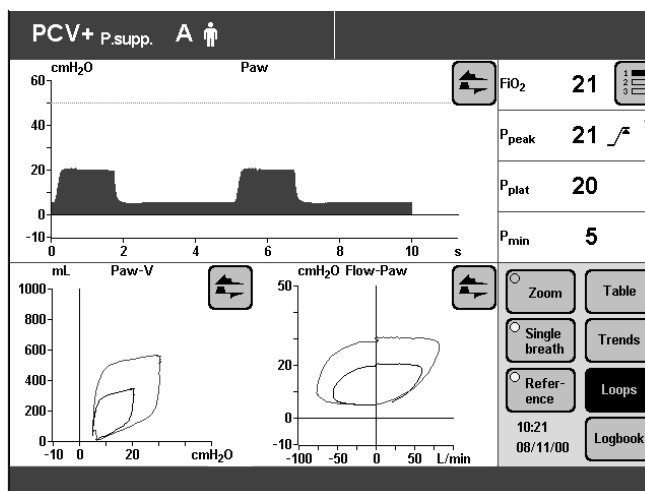
When the single breath display is not selected, Evita 4 will display all respiratory activity from one mandatory breath to the next.

### Zooming loops\*

The right loop may be enlarged to fill the screen using the upper and lower graphics fields.

- Touch »**Zoom**« screen key.  
Display of the "Loop" page.  
The right loop will be enlarged, the other loop and the time domain waveforms disappear.

**NOTE:** You may also select the loop to be displayed while in the loop page.



\* This feature is available as an upgrade to users of Evita 4 4.n software

To return to the normal loop display format:

- Touch » **Zoom** « screen key.

When leaving the loop page, the time domain waveforms will reappear.

### Displaying loops in the upper graphics field\*

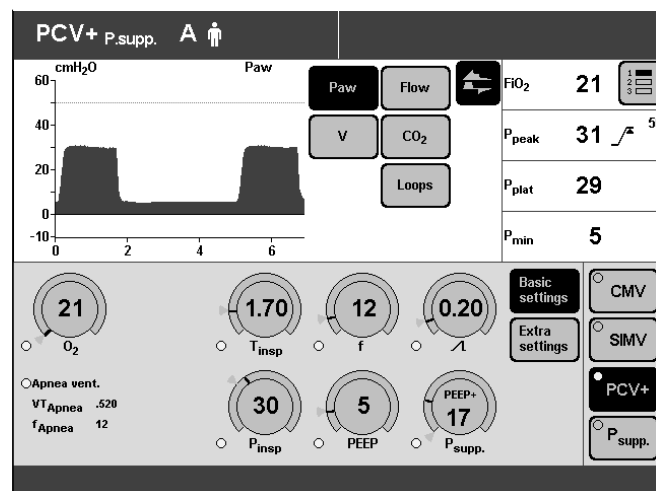
- Touch »  « screen key
- Touch » **Loops** « screen key.

The time domain waveforms in the upper graphics field are replaced by the two loops.


The screen freeze function is also available for loops displayed in the upper graphics field.

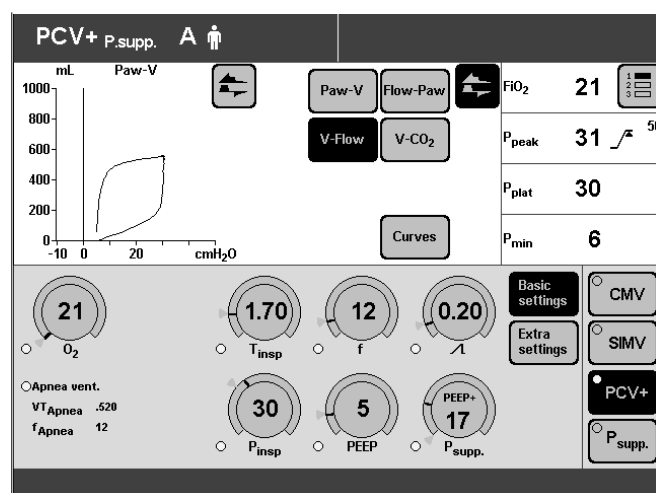
Loops in the upper graphics field cannot be configured, if

- the » **Loops** « menu is open, or
- the » **Configuration** « key is selected.



To return to time domain waveforms in the the upper graphics field:

- Touch the »  « screen key,
- touch the screen key of the waveform desired.



\* This feature is available as an upgrade to users of Evita 4 4.n software

## Logbook

Evita 4 records settings and alarms at the time of their occurrence into an event log.

- Touch »Logbook« key.

»Logbook« display (example):

Alarms and settings are presented as a vertical list in chronological order.

To the right of the log entries, the ventilator shows the status of settings including the respective date and time.

To select an older entry:

- Turn dial knob clockwise and position cursor frame over the desired entry.  
Example: 12.04. 12:27 / Apnea: 15 s -> 30 s

To select a more recent entry:

- Turn dial knob counter-clockwise and position cursor frame over the desired entry.

Evita 4 records all alarms in the log. An alarm that was not immediately displayed at the time of its occurrence, e.g. because the ventilator was displaying an alarm with higher priority at the time, will be marked with a small star in the log (\*). If the alarm was displayed immediately, it appears without the star.

## Screen Freeze

To "freeze" waveforms and loops (freezing of loops as an available option):

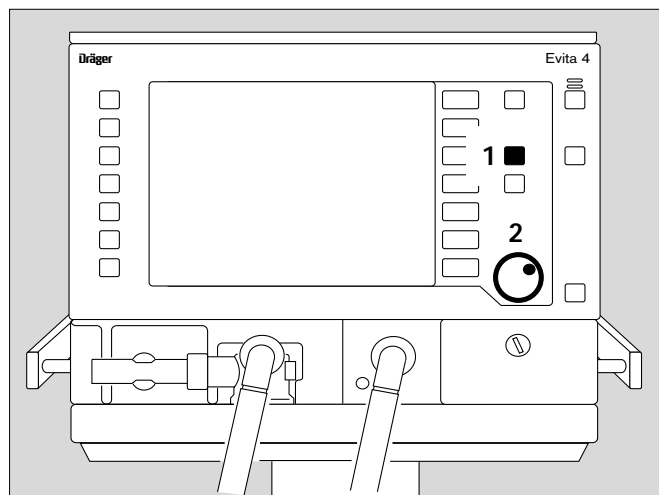
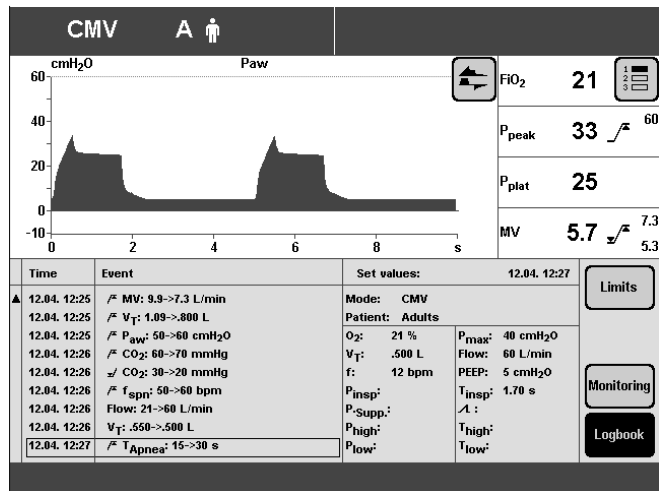
- 1 Press »Freeze« key.  
To display a pair of measured values or a point of a curve or loop:
- 2 Turn dial knob to position the cursor on the desired time.  
The associated measured value pair is displayed above, respectively next to the waveform.

**NOTE:** As long as the freeze-function is active, the »Reference« screen key will be unavailable.

To restart waveforms or loops:

- 1 Press »Freeze« key again.

The screen freeze is cancelled automatically 3 minutes after the last turning of the dial knob.





## Special Functions

### Manually Timed Breaths (Inspiratory Hold)

This function may be used in all modes except CPAP without Pressure Support.

Depending on the start time, an automatic ventilator breath is either prolonged for a maximum of 15 seconds, or,  
a new ventilator breath is manually started and held for max. 15 seconds between two automatic ventilator breaths.

The pattern of a manually timed breath is determined by the ventilation mode used.

For CPAP/P.Supp.  
a pressure controlled ventilator breath is started (defined by setting of P<sub>Supp.</sub>).

- 1 Press »**Insp. hold**« key and hold it down for as long as inspiration is required.

Either an already activated automatic ventilator breath will be prolonged or a new ventilator breath will be started and appropriately prolonged – max. 15 seconds.

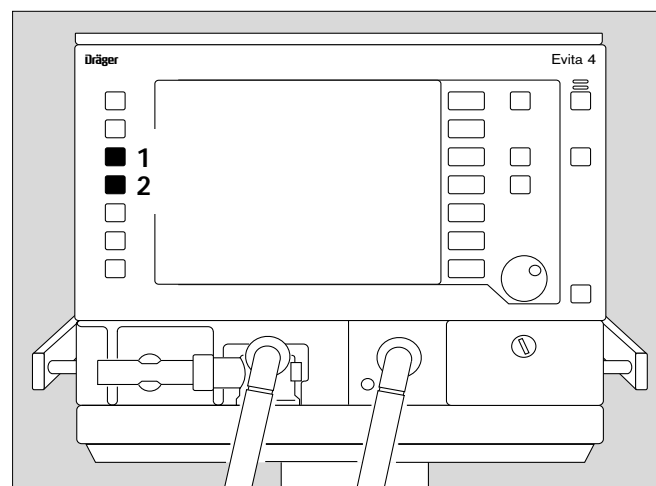
### Manually Timed Expiration (Expiratory Hold)

This function may be used in all ventilation modes.

- 2 Press and hold »**Exp. hold**« key.

Evita 4 stays in expiration as long as the key is pressed and determines the value of NIF<sup>1)</sup>.

Expiration is terminated after 15 seconds if key is still pressed at that time.



1) See page 96 for displaying NIF  
For a detailed description of NIF, see "Theory of Operation" page 194.

## Nebulizing Aerosols

### During ventilation in adult mode

Nebulizer may be used in all ventilation modes. Evita 4 administers the medicated aerosols synchronized with inspiration, while automatically maintaining the preset minute volume.

Depending on the O<sub>2</sub> concentration set, the ventilator supplies the nebulizer with air, oxygen or a mixture of air and oxygen. Deviations from the set O<sub>2</sub> concentration are thus kept as low as possible.

**NOTE:** In extreme cases (with a minimum inspiratory flow of 15 L/min), the deviations can be up to  $\pm 4$  Vol.%\*. In order to avoid greater deviations, the nebulizer is switched off at inspiratory flows below 15 L/min.

### During ventilation in pediatric mode

Nebulizing of medicated aerosols is possible in pressure controlled ventilation modes.

In volume controlled ventilation modes nebulizing is only possible while using AutoFlow®.

In contrast to nebulizing in adult patient mode, aerosol is delivered continuously in pediatric mode. Aerosol generated during expiration does not, however, reach the lung.

Depending on the O<sub>2</sub> concentration set, the ventilator supplies the nebulizer with air, oxygen or a mixture of air and oxygen. Deviations from the set O<sub>2</sub> concentration are thus kept as low as possible.

**NOTE:** It is recommended not to use the nebulizer while ventilating at breath rates below 12 bpm.

For breath rates above 12 bpm, consult the diagram on page 196 for delivered O<sub>2</sub> concentration.

The maximum deviation from set O<sub>2</sub> concentration is  $\pm 4$  Vol.%\*.

### WARNING !

For breath rates below 12 bpm, deviations from set oxygen concentration can be significantly higher in extreme cases.

These deviations cannot be monitored by the internal O<sub>2</sub> analyzer of the ventilator.

\* For a detailed description of the inspiratory O<sub>2</sub> concentration when nebulizing, please refer to "Theory of Operation", page 196.

After 30 minutes, the ventilator will switch nebulizer off automatically.

After the delivery of aerosol, the flow sensor is automatically cleaned and calibrated, in order to prevent any malfunction in the flow monitoring system.

Prepare nebulizer in accordance with its Instructions for Use.

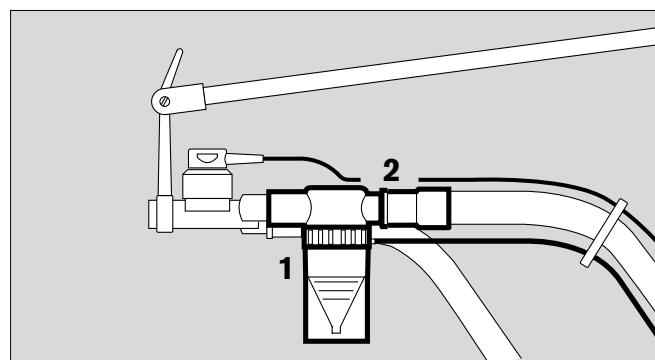
#### Preparation for nebulizer 84 12 935:

##### **WARNING !**

The integrated nebulizer function of Evita 4 is designed for nebulizers with a nebulizing flow of 6 L/min at 29 psi (2 bar), for example nebulizer 84 12 935 (white central body). Other nebulizers may cause considerable deviations in tidal volume and inspiratory O<sub>2</sub> concentration!

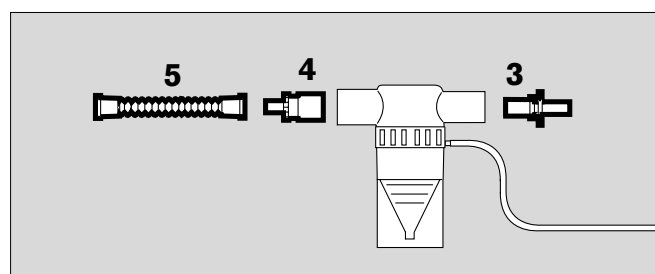
#### For use while ventilating adults

- 1 Connect nebulizer to inspiratory side (temperature sensor side) of the Y-piece.
- 2 Connect inspiratory circuit to nebulizer.
- Place nebulizer in a vertical position.
- Using clips supplied with patient circuits, route nebulizer hose back to the ventilator along the expiratory circuit.

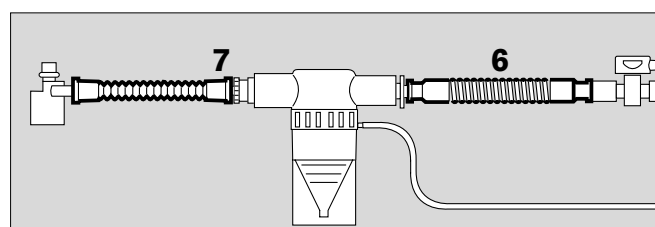


#### For use while ventilating children and infants

- 3 Insert tapered adapter (ISO Ø15 / Ø11) into nebulizer entry port.
- 4 Insert tapered adapter (ISO Ø22/ Ø11) into nebulizer output port.
- 5 connect corrugated silicone circuit segment (part no. 84 09 634, 0.13 m) to the nebulizer output port.



- 6 Remove corrugated patient circuit element from the inspiratory port on the Y-piece and connect to the inspiratory port of the nebulizer instead.
- 7 Attach the free end of the corrugated circuit installed to the expiratory port of the nebulizer to the inspiratory port of the Y-piece.



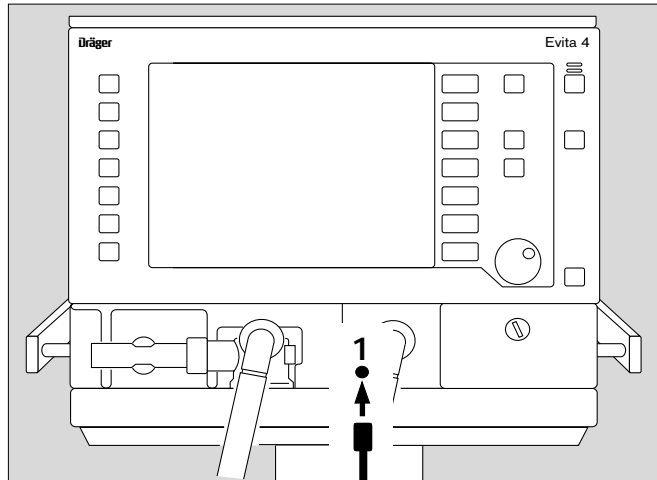
- 1 Connect nebulizer hose onto the nipple in the front of the Evita 4 ventilator unit.
- Fill nebulizer in accordance with its respective Instructions for Use.

#### **WARNING !**

**Consider effects of aerosols on sensors, filters, and heat and moisture exchangers (HMEs)!  
The measuring function of the flow sensor may be impaired.**

**The flow resistance of filters is liable to increase and may impair ventilation.**

**Do not put a microbial filter on the nebulizer outlet when in use!**



#### **WARNING !**

**Do not use a heat/moisture exchanger simultaneously with a nebulizer or heated humidifier!**

**Risk of increased breathing resistance due to condensation**


- 2 Hold down »  **Neb.**« key until the yellow LED lights up.

- Advisory message on screen:

**Nebulizer on!**

The nebulizer now operates for 30 minutes.

If nebulizing needs to be stopped early:

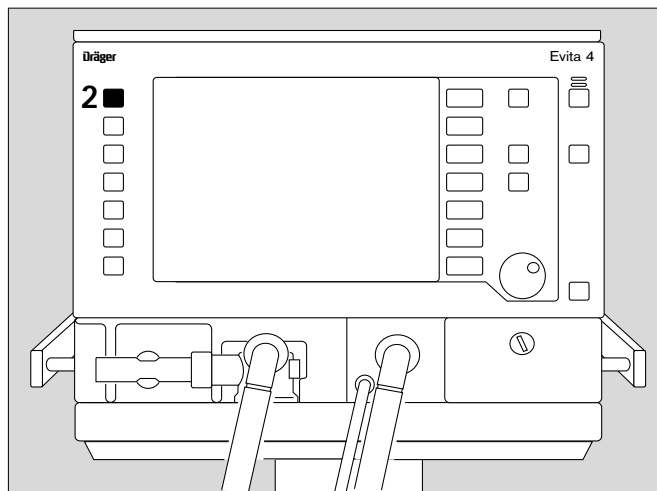
- 2 Press »  **Neb.**« key again. The yellow LED will go out and the nebulizer is switched off.

The flow sensor is then automatically cleaned and calibrated.

- Screen message:

**Flow calibration**

- Remove any leftover nebulizing solution. Consult nebulizer Instructions for Use.



## Pre-/Post-Oxygenation for Bronchial Suction

To avoid any risk of hypoxia during bronchial suction, Evita 4 offers programmed elevation of oxygen concentrations during the removal of secretions.

After starting the program, Evita 4 ventilates in the set ventilation mode for 180 seconds as pre-oxygenation; - in adult patient mode with 100 Vol.% O<sub>2</sub>, in pediatric patient mode with an O<sub>2</sub> concentration that is 25% higher than the set concentration (e.g. set value 60 Vol.%, delivered 75 Vol.%).

When disconnection for suction occurs, Evita 4 interrupts ventilation. During the time for suction, audible alarms are silenced in order to not disturb the suction routine.

After suction and reconnection, Evita 4 ventilates in the set ventilation mode for 120 seconds as post-oxygenation; - in adult patient mode with 100 Vol.% O<sub>2</sub>, in pediatric patient mode with an O<sub>2</sub> concentration that is 25% higher than the set concentration.

During suction and for 2 minutes afterwards, the lower alarm limit for minute volume is switched off.

Other alarms are switched off during suction and for 15 seconds afterwards.

**NOTE:** Pre-/Post oxygenation is only possible with a functioning flow sensor and while flow monitoring is switched on.

## Activating the Oxygenation Program

### Before suction

- 1 Hold down the »O<sub>2</sub> ↑ Suction« key until the yellow LED lights up. Evita 4 ventilates in the set ventilation mode; - in adult patient mode with 100 Vol.% O<sub>2</sub>, in pediatric patient mode with an O<sub>2</sub> concentration that is 25% higher than the set concentration.  
If PEEP is not set to more than 4 cmH<sub>2</sub>O, PEEP will be applied automatically at 4 cmH<sub>2</sub>O. This PEEP will enable Evita 4 to detect any subsequent disconnection.

All other ventilation parameters remain unaffected.

- Display in the help line at the bottom edge of the screen:

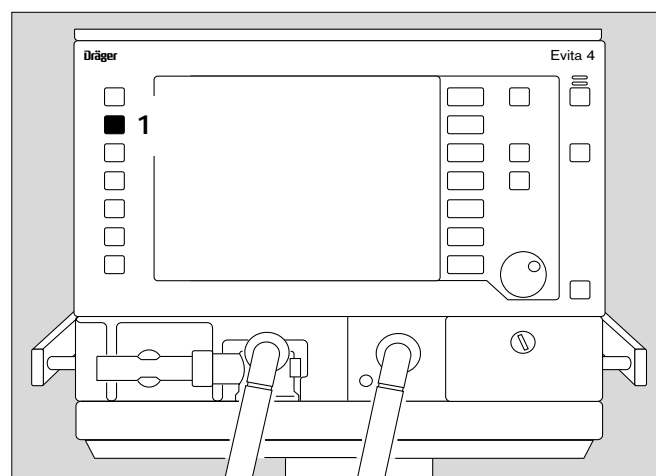
### O<sub>2</sub> enrichment 180 s

The remaining time is continuously displayed.

Pre-oxygenation lasts for a maximum of 180 seconds.

During this time, Evita 4 waits for the disconnection associated with suction.

If no disconnection is detected within 180 seconds, the oxygenation program will terminate.



#### After disconnecting for suction

Evita 4 delivers a very small continuous flow for the duration of suction. This enables the ventilator to detect the end of deconnection. In the help line at the bottom edge of the screen, the time remaining for suction is displayed continuously in seconds (example):

##### Execute suction and reconnect 120 s

If suction is completed and the patient reconnected within the time indicated, Evita 4 will end the deconnection phase.

#### Automatic canceling of oxygenation program.

If there is still no reconnection detected after 120 seconds, the oxygenation program is interrupted. Alarms are immediately reactivated. Evita 4 then immediately continues ventilating in the set ventilation mode.

#### After reconnection

After reconnection, Evita 4 continues to ventilate in the set ventilation mode, but with 100 Vol. % O<sub>2</sub> in adult patient mode, in pediatric patient mode with a 25% elevated O<sub>2</sub> concentration for another 120 seconds as post-oxygenation.

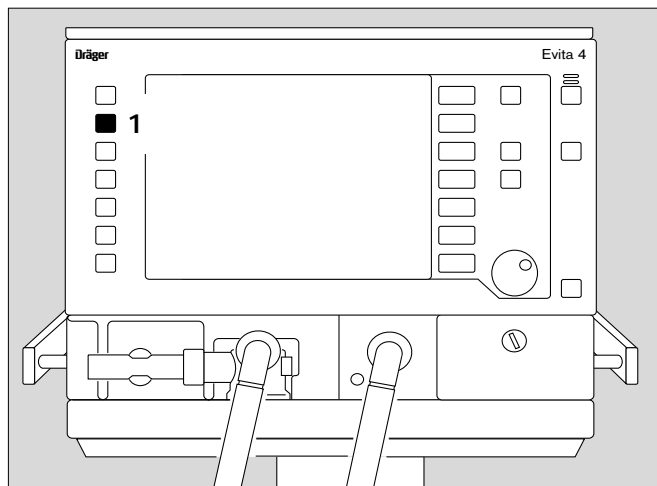
- Display in the help line at the bottom of the screen:

##### Final O<sub>2</sub> enrichment 120 s

The remaining time is displayed continuously.

If you need to cancel the oxygenation program:

- 1 Press »O<sub>2</sub>↑ Suction« key again.



## Special Procedure: Intrinsic PEEP

Intrinsic PEEP\* is the actual end-expiratory pressure in the lung.

Due to the dynamics of lung mechanics (resistance, compliance and closing volume) and the set parameters of ventilation, Intrinsic PEEP differs from PEEP in the upper airways.

The Intrinsic PEEP measuring maneuver also measures the trapped volume resulting from the different PEEP values, i.e. the amount of air trapped in the lungs and not taking part in the process of gas exchange.

This maneuver can be performed in all ventilation modes.

**NOTE:** Activity by the patient during this maneuver can distort the values measured.

To select the Intrinsic PEEP maneuver:

- Press »**Special proc.**« key and touch »**PEEPi**« screen key.

Display (example):

The measured values and the time of the last measurement are displayed on screen.

To start measurement of Intrinsic PEEP:

- Touch »**Start**« screen key.

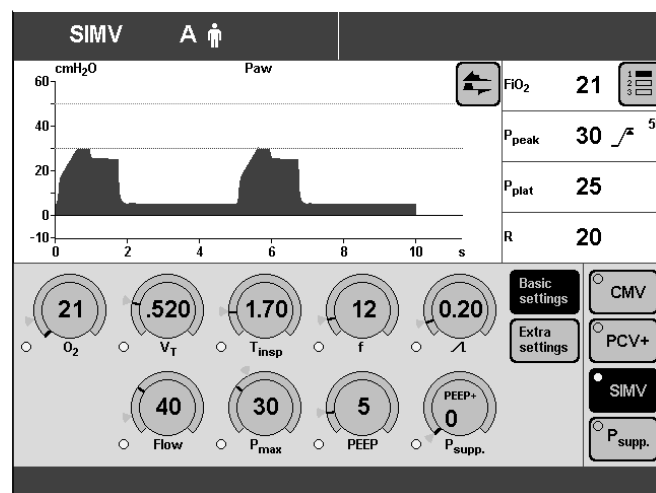
The Intrinsic PEEP maneuver is performed automatically.

At the end of the maneuver, the new measured values PEEP<sub>i</sub> and V<sub>trap</sub> are displayed.

The waveform display is automatically stopped.

To evaluate the measured value at a particular time:

- Position hairline cursor on the time by turning dial knob.  
The associated measured value is displayed above the waveform.



\* For detailed description, see "Theory of Operation", page 195.

## Special Procedure: Occlusion Pressure P 0.1

Occlusion pressure P 0.1 characterizes the negative pressure during a short occlusion (0.1 s) at the start of spontaneous inspiration.

It is a direct measure of a patient's neuromuscular breathing drive.

Patients with healthy lungs and regular breathing generate a pressure drop of  $-3$  to  $-4$  cmH<sub>2</sub>O = P 0.1.

Values below  $-4$  cmH<sub>2</sub>O represent a high breathing drive which can only be maintained for a short time.

Values exceeding  $-6$  cmH<sub>2</sub>O for a patient with chronic obstructive pulmonary disease indicate impending exhaustion.

This measuring maneuver can be used in all ventilation modes in order to check the breathing drive of a spontaneously breathing patient or to assess the amount of spontaneous breathing during controlled ventilation.

To select the P 0.1 occlusion pressure measuring maneuver:

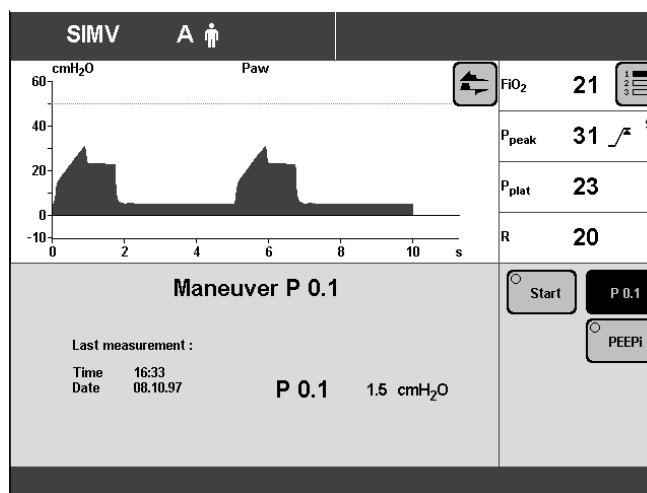
- Press »**Special procedure**« key and touch screen key »**P 0.1**«.

Display (example):

The measured value and time of the last measurement are displayed on screen.

To start the P 0.1 occlusion pressure measuring maneuver:

- Touch »**Start**« screen key.



The P 0.1 maneuver is performed automatically.

At the end of the maneuver, the waveform display is automatically stopped.

To evaluate the measured value at a particular time:

- Position hairline cursor on the time by turning the dial knob.  
The associated measured value is displayed above the waveform.  
Evita 4 displays the value for P 0.1 as subambient pressure without a negative sign.



## Switching Off Monitor Functions

e.g. if a spent sensor cannot be replaced immediately.

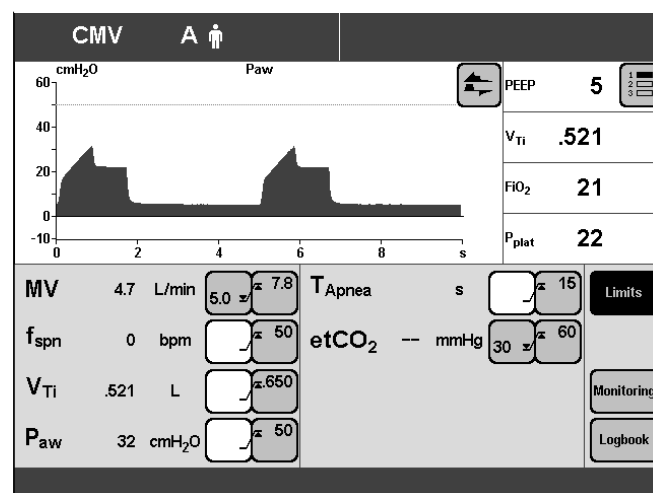
### WARNING !

In case of malfunction of any of the built-in monitoring a substitute has to be provided in order to maintain an adequate level of monitoring. The operator of the ventilator must still assume full responsibility for proper ventilation and patient safety in all situations.

Example: Switching off flow monitoring.

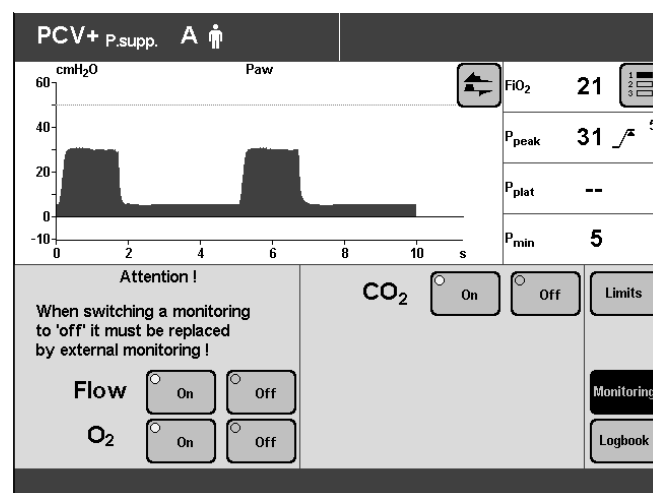
- Press »Alarm limits« key.

Display (example):



- Touch »Monitoring« screen key.

Display (example):



For the example of switching off flow monitoring:

- Touch »Off« screen key associated with **Flow**. The key changes color from green to yellow.

To confirm that you wish to switch off flow monitoring:

- Press dial knob. Flow monitoring is switched off and the corresponding measured values disappear. The respective alarm is switched off.

After replacing the sensor:

- Switch monitoring function back on.

## Selecting Standby Mode

### Selecting Standby Mode

- To perform the ventilator check
- To maintain Evita 4 ready for operation while no patient is connected
- To change between patient modes.

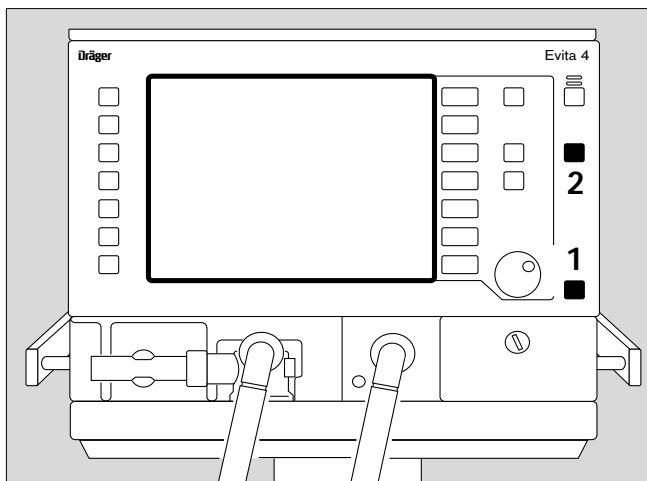
1 Hold down »**Stand by**« key for about 3 seconds.

An audible alarm sounds after switching to standby.

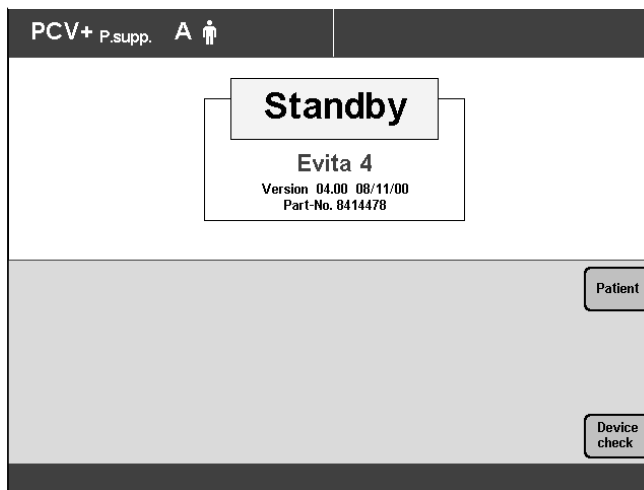
To switch off the standby audible alarm:

2 Press »**Alarm Reset**« key.

**NOTE:** The standby alarm cannot be silenced with the »**Alarm Silence**« key.



Display (example):



In case the patient mode or ideal body weight should have changed during Standby, Evita 4 will determine new start values for ventilation, see page 68.

### Terminating standby mode

- to continue ventilation.

1 Press »**Stand by**« key.

The LED will go out and all current ventilation parameters will again be effective.

## Calibrations

**NOTES:** The last calibration/zeroing values remain stored until the next calibration/zero calibration, even when the ventilator is switched off.

Calibration of the pressure sensors for measuring the airway pressure is automatic.

An automatic calibration of flow and O<sub>2</sub> sensor is performed daily.

Manual calibration of the flow sensor may be performed at any time, even during ventilation.

Manual calibration of the O<sub>2</sub> sensor may be performed at any time, even during ventilation. The applied O<sub>2</sub> concentration is not affected by calibration.

The calibration of the CO<sub>2</sub> sensor may be checked during ventilation.

### Calibrating the O<sub>2</sub> Sensor

- Before operation, during the ventilator check
- After replacing the O<sub>2</sub> sensor  
(wait until after 15-minute warm-up of the O<sub>2</sub> sensor)
- If the measured value and set value deviate from each other by more than 2 Vol. %

The O<sub>2</sub> sensor can be calibrated during ventilation.

Start calibration:

- Press »Calibration« key.

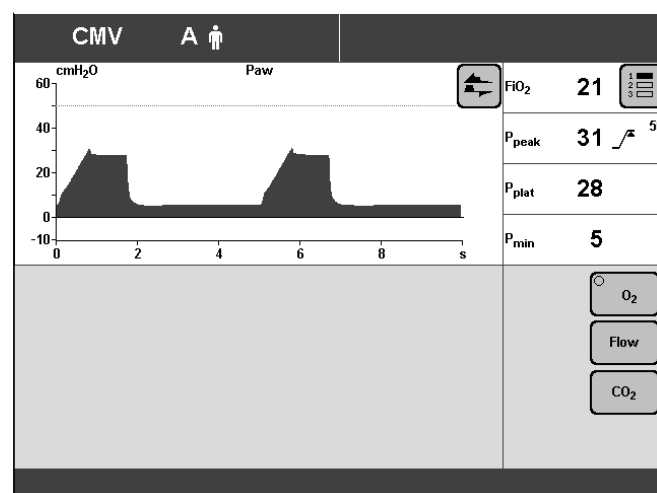
Display (example):

- Touch »O<sub>2</sub>« screen key.  
The "LED" in the screen key changes its color to yellow.

Message in the help line at the bottom of the screen:

#### O<sub>2</sub> calibration

After calibration is complete, the yellow "LED" in the screen key is switched off



## Calibrating the Flow Sensor

- Before operation, during the ventilator check
- After replacing the flow sensor

Before each calibration, the flow sensor is automatically cleaned.

After using the nebulizer, the flow sensor is automatically cleaned and calibrated.

### WARNING !

The hot wire in the flow sensors is heated well above its normal operating temperature during the cleaning process. Therefore, avoid flammable gases (e.g. ethanol vapors after disinfection).

Vent flow sensors after disinfection with ethanol for at least 30 minutes.

To start calibration:

- Press »**Calibration**« key.
- Touch »**Flow**« screen key.  
The "LED" in the screen key changes its color to yellow.

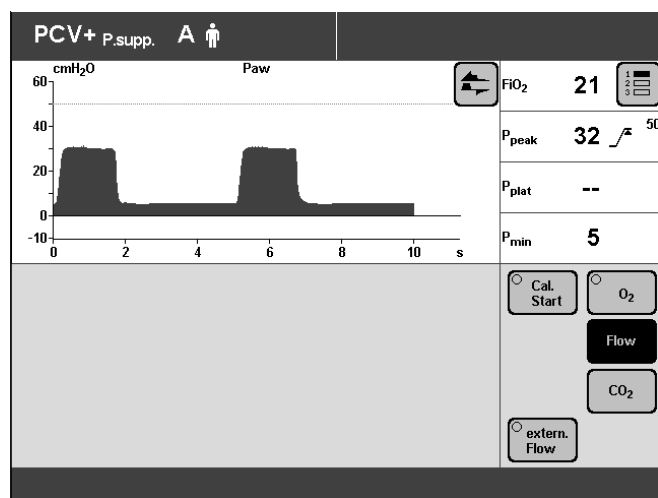
Display (example):

Evita 4 uses the next inspiration for the calibration. Short inspiratory times are prolonged to about 1 second.

Message in the help line at the bottom of the screen:

### Flow Calibration

After calibration is complete, the yellow "LED" in the screen key is switched off.



## External Flow Source

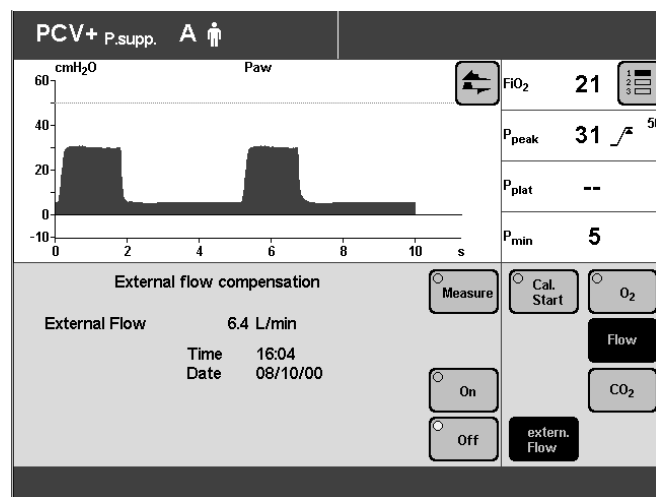
Whenever a constant, external flow is added (e.g. when operating a nebulizer from an external gas source and not from the Evita nebulizer gas supply), Evita is able to take this flow into account and to increase the thresholds for flow sensor monitoring. This helps to avoid "Flow measurement inop." or "Neo.flow measuring fault" (Option NeoFlow) in these cases.

The original measurement of expiratory volume remains unchanged.

For the expiratory flow Evita 4 will therefore measure a correspondingly higher value for  $VT_e$  and MV.

In order to avoid alarms:

- Adjust upper alarm limit for MV.



Calculation of external flow may be switched on or off.

To have Evita 4 calculate external flow:

- Press »**Calibration**« key,
- touch »**Flow**« screen key,
- touch »**Extern. Flow**« screen key.

To activate external flow calculation:

- Touch »**Measure**« screen key,
- press dial knob to confirm.
- The yellow "LED" in the »**Measure**« screen key is now lit.

Evita 4 now calculates the amount of external flow.

During this calculation, Evita 4 displays:

### External flow will be determined

When the external flow has been calculated, Evita 4 will display it together with a time and date stamp.

Simultaneously, Evita displays the message:

**Confirm value with** ☉

- Press dial knob to confirm.

As long as Evita is taking external flow into account, it shows the advisory message:

### External flow

When no external flow is applied any more:

- Switch off using the »**Off**« screen key.

## With the CapnoPlus Option Installed: Checking/Calibrating the CO<sub>2</sub> Sensor

The CO<sub>2</sub> sensor is factory calibrated and can be used without further calibration on any Evita 4 ventilator. A CO<sub>2</sub> zero calibration is performed as part of the ventilator check.

Calibration of the CO<sub>2</sub> sensor is only required:

- if, upon checking calibration with a test filter or with calibration gas, the specified test values are not met,
- during the six-month preventive maintenance inspections.

The calibration check or calibration may be performed during ventilation.

## Performing a CO<sub>2</sub> Zero Calibration

- If the ventilator requests CO<sub>2</sub> zero calibration with the screen message: **CO<sub>2</sub> zero calibration?**
- If the CO<sub>2</sub> curve no longer returns to zero after each inspiration
- Before each calibration test, see page 116 or 117
- Before each CO<sub>2</sub> calibration, page 119.

- Switch Evita 4 on. Wait about 3 minutes for complete warm-up of the CO<sub>2</sub> sensor.

After about 3 minutes, the measured values will be within the specified accuracy.

- Press »**Calibration**« key.

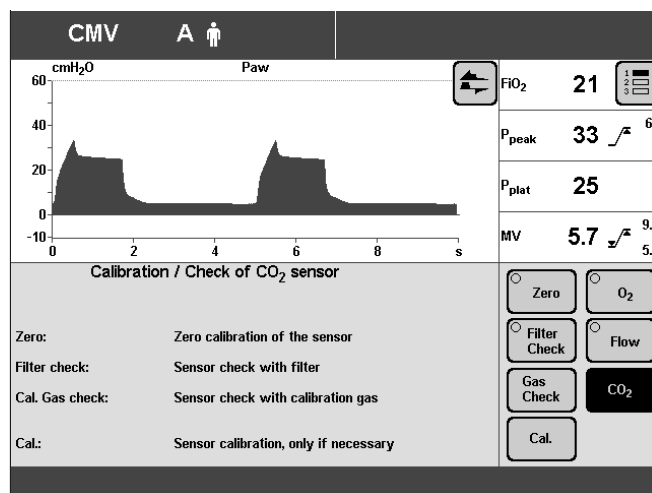
Display (example):

- Touch »**CO<sub>2</sub>**« screen key.
- Touch »**Zero**« screen key.

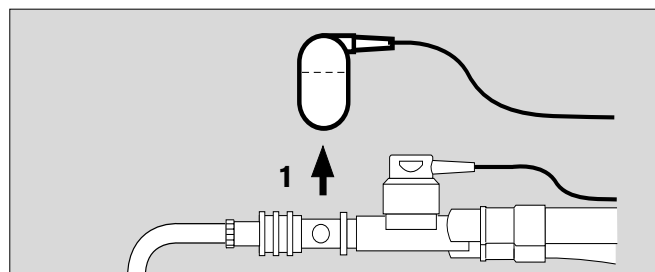
Message:

### Park CO<sub>2</sub> sensor

- Press dial knob to confirm.



1 Remove CO<sub>2</sub> sensor from cuvette,

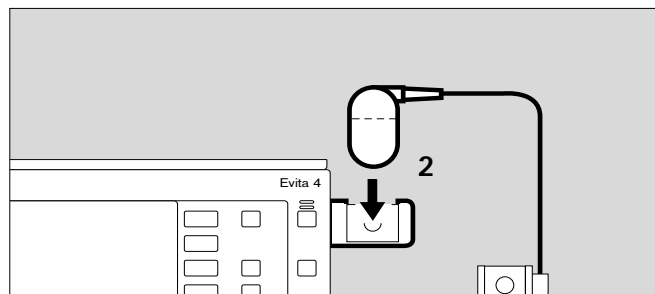


2 place sensor on its park bracket,

- confirm with dial knob:  
CO<sub>2</sub> zero calibration will now be performed.

Display:

**CO<sub>2</sub> zero calibration**



After about 5 seconds, the ventilator confirms with the message:

**CO<sub>2</sub> zero ok**

- Fit sensor back on the cuvette.

The ventilator indicates a failed zero calibration with the message:

**CO<sub>2</sub> zero?**

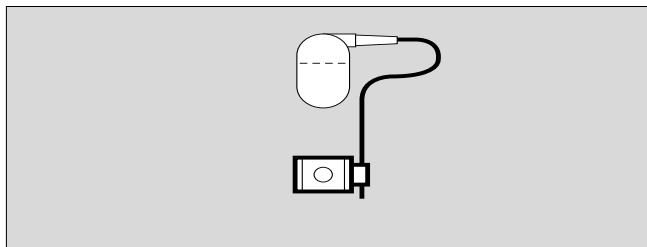
See "Troubleshooting", page 157.

- Repeat CO<sub>2</sub> zero calibration.

## Testing CO<sub>2</sub> Calibration With Test Filter

Use test filter provided on the CO<sub>2</sub> sensor cable.

- Switch on Evita 4 and wait for about 3 minutes for the CO<sub>2</sub> sensor to complete its warm-up.

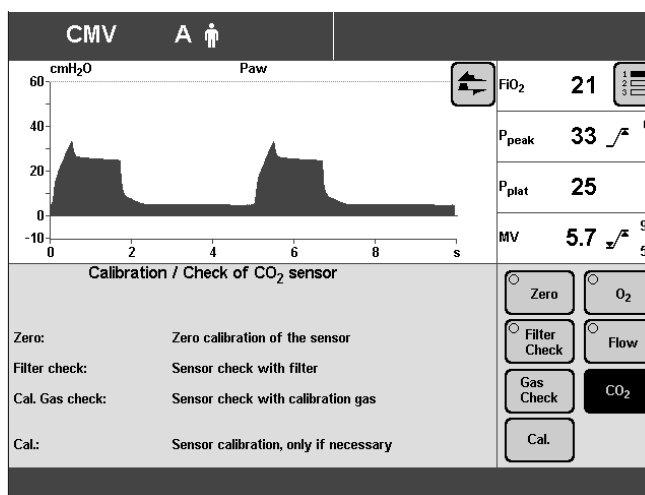


- Press »**Calibration**« key.

Display (example):

- Touch »**CO<sub>2</sub>**« screen key.

Display (example):

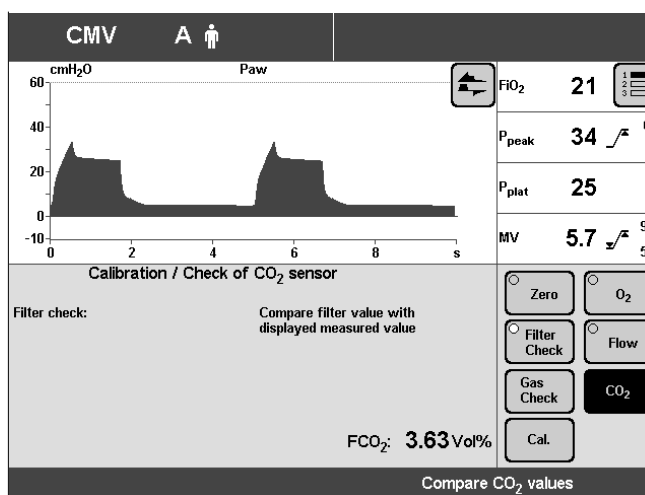


- Perform CO<sub>2</sub> zero calibration, see page 114.

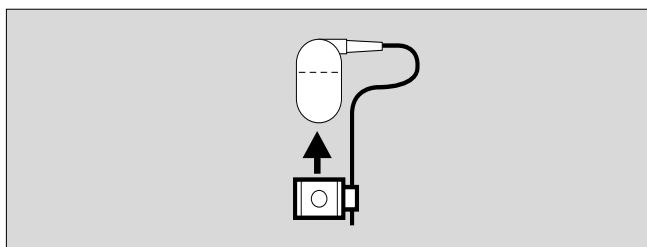
After CO<sub>2</sub> zero calibration:

- Touch »**Filter Check**« screen key.

Display (example):



- Place test filter into the CO<sub>2</sub> sensor.





The screen displays the test value of the CO<sub>2</sub> concentration FCO<sub>2</sub>.

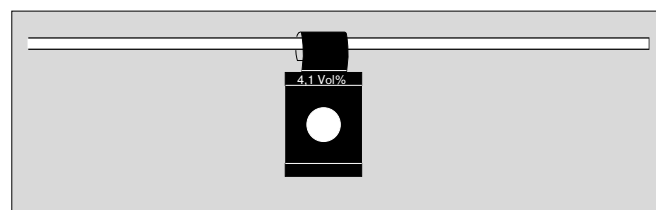
This value must agree with the specification on the test filter within  $\pm 0.3$  Vol. %.

Example: 4.1 Vol. % on the filter:

permitted value range: 3.8 to 4.4 Vol. %.

If the test value is outside the permitted tolerance, the sensor must be checked or calibrated with calibration gas.

- Push CO<sub>2</sub> sensor back on the cuvette.

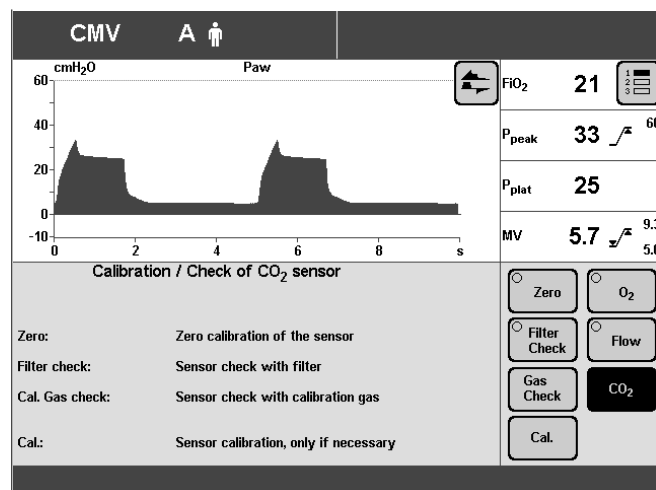


## Testing CO<sub>2</sub> Calibration With Calibration Gas

- If the specified calibration value was not met when testing with the test filter
- At least once every six months.
- Switch on Evita 4. Wait about 3 minutes for the CO<sub>2</sub> sensor to complete its warm-up.
- Press »Calibration« key.

Display (example):

- Touch »CO<sub>2</sub>« screen key.

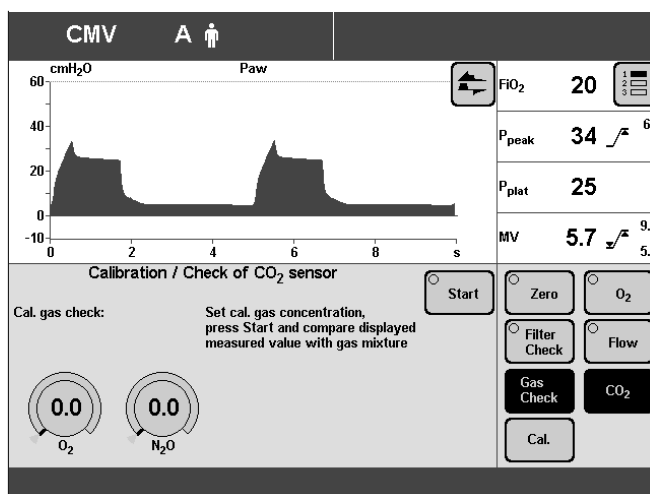


Display (example):

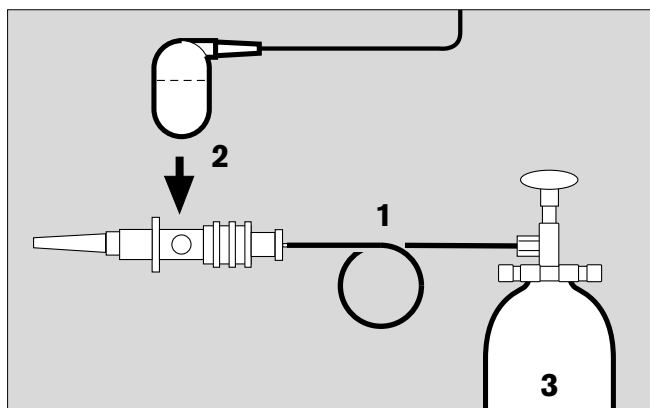
- Perform CO<sub>2</sub> zero calibration, see page 114.

After completing CO<sub>2</sub> zero calibration:

- Touch »**Gas Check**« screen key.



- Connect calibration gas supply.  
Use the cuvette from the calibration set!
- 1 Connect calibration gas cylinder and cuvette of the calibration set to the hose.
- 2 Remove CO<sub>2</sub> sensor from its park bracket and mount on the cuvette of the calibration set.
- Read CO<sub>2</sub>, O<sub>2</sub> and N<sub>2</sub>O concentrations (Vol.%) of the calibration gas from test cylinder.
- 3 Calibration gas e.g.: 5 Vol.% CO<sub>2</sub>  
95 Vol.% N<sub>2</sub>
- Enter these concentration values with the on-screen parameter setting knobs.  
Touch the respective screen knob.  
Enter concentration = turn dial knob.  
If the calibration gas consists only of CO<sub>2</sub> and N<sub>2</sub>, set O<sub>2</sub> and N<sub>2</sub>O concentrations to 0.
- Touch »**Start**« screen key.



The CO<sub>2</sub> concentration **FCO<sub>2</sub>** is displayed on-screen.

After about 10 seconds, the value of FCO<sub>2</sub> must match the CO<sub>2</sub> content of the calibration gas within  $\pm 0.2$  Vol. % .

If the calibration value is outside the permitted tolerance, the CO<sub>2</sub> sensor must be recalibrated with calibration gas.

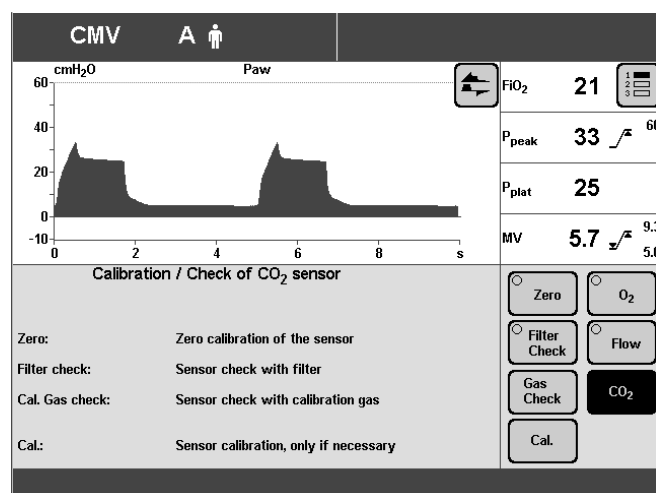
- Push CO<sub>2</sub> sensor back on the cuvette.

## Calibrating the CO<sub>2</sub> Sensor

The CO<sub>2</sub> sensor must be calibrated:

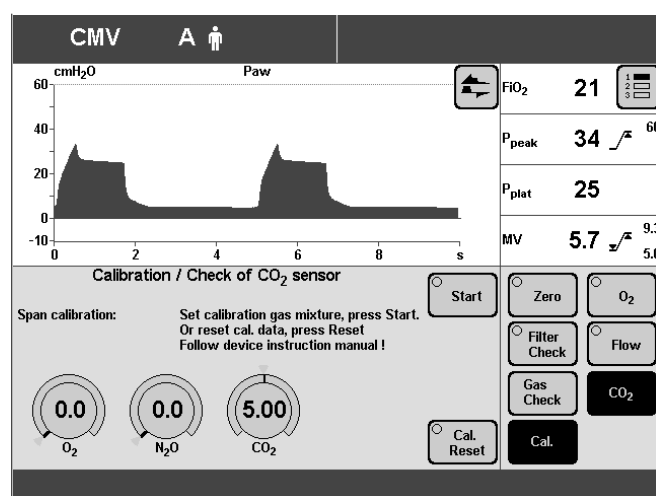
- if the specified calibration values are not met when checking calibration with filter or calibration gas.
- as part of the six month preventive maintenance inspection of Evita 4.
- Switch on Evita 4. Wait about 3 minutes for the CO<sub>2</sub> sensor to complete its warm-up.
- Press »Calibration« key.

Display (example):



- Touch »CO<sub>2</sub>« screen key.

Display (example):

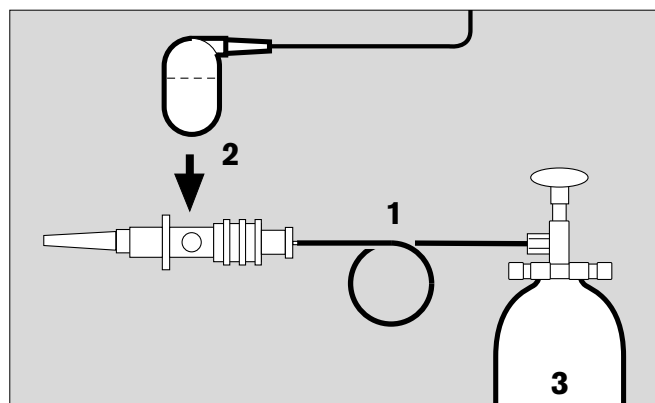


- Perform CO<sub>2</sub> zero calibration, see page 114.

After the CO<sub>2</sub> zero calibration:

- Touch »Cal.« screen key.

- Connect calibration gas supply. Use cuvette from the calibration set!
- 1 Connect calibration gas cylinder and calibration cuvette to the hose.
- 2 Remove CO<sub>2</sub> sensor from its park bracket and mount it on the calibration cuvette.
- Read CO<sub>2</sub>, O<sub>2</sub> and N<sub>2</sub>O concentrations (Vol.%) of calibration gas from test cylinder.
- 3 Calibration gas e.g.: 5 Vol.% CO<sub>2</sub>  
95 Vol.% N<sub>2</sub>



- Enter these concentration values with the on-screen parameter setting knobs.  
Touch the respective screen knob.  
Turn dial knob to enter concentration.  
If the calibration gas consists only of CO<sub>2</sub> and N<sub>2</sub>, set O<sub>2</sub> and N<sub>2</sub>O concentrations to 0.
- Touch »**Start**« screen key.

During calibration, the following message is displayed on the screen:

**CO<sub>2</sub> calibration Please wait**

Evita 4 performs calibration and confirms with the message:

**CO<sub>2</sub> calibration OK**

A failed calibration is indicated by the ventilator with the message:

**CO<sub>2</sub> calibration interrupted**

or

**CO<sub>2</sub> calibration not OK**

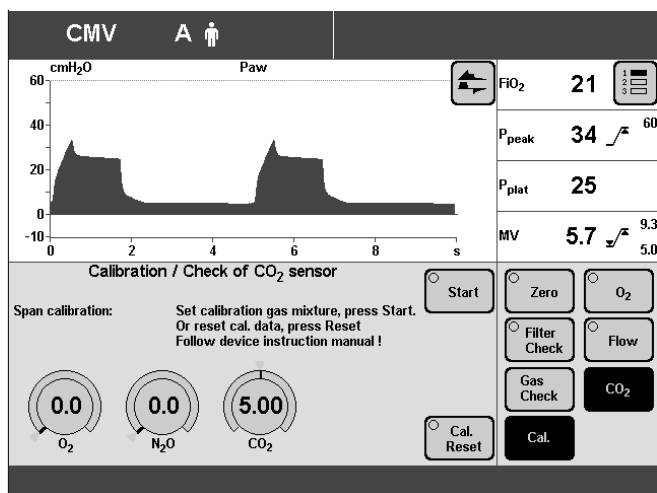
Repeat calibration of the CO<sub>2</sub> sensor.

## Resetting CO<sub>2</sub> Calibration

- If calibration with calibration gas was unsuccessful, the factory set calibration value may initially be used.
- Press »**Calibration**« key.
- Touch »**CO<sub>2</sub>**« screen key.
- On the CO<sub>2</sub> calibration page, touch »**Cal.**« screen key, then touch »**Reset**« screen key.

After about 5 seconds, resetting is complete, and the factory set calibration value is reactivated.

**Perform a valid calibration as soon as possible!**



## Configuration

### Contents

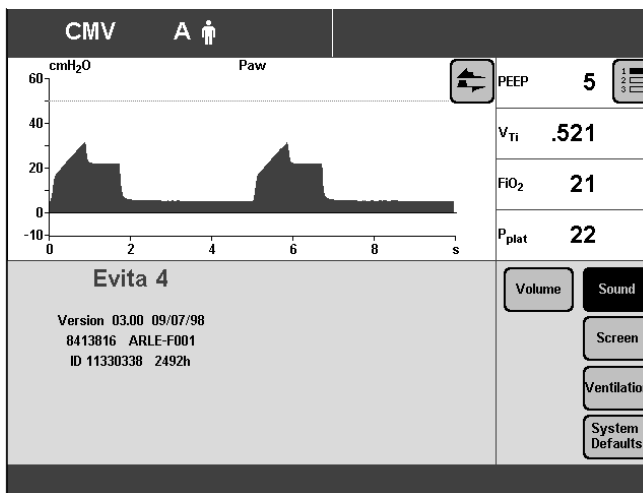
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## Sound

### Adjusting Volume of the Audible Alarm

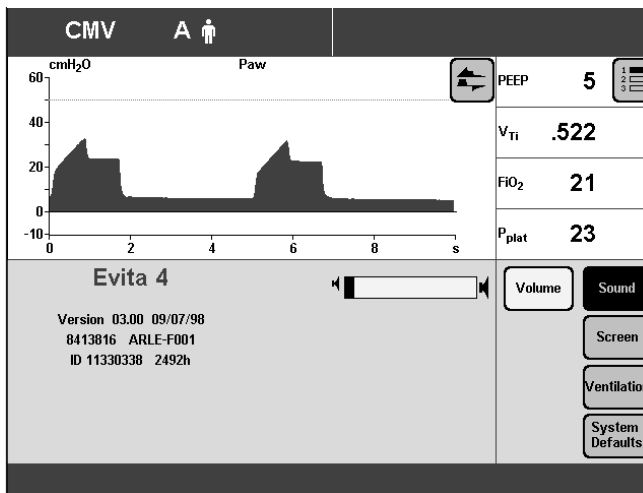
- Press »**Configuration**« key.
- Touch »**Sound**« screen key.

Display (example):



- Touch »**Volume**« screen key.

Display (example):




- Turn dial knob to adjust volume.  
The horizontal bar graph displayed on screen shows the current setting between minimum and maximum.
- Press dial knob to confirm setting.  
After confirmation, the audible alarm sounds in order to test set volume.

## Screen

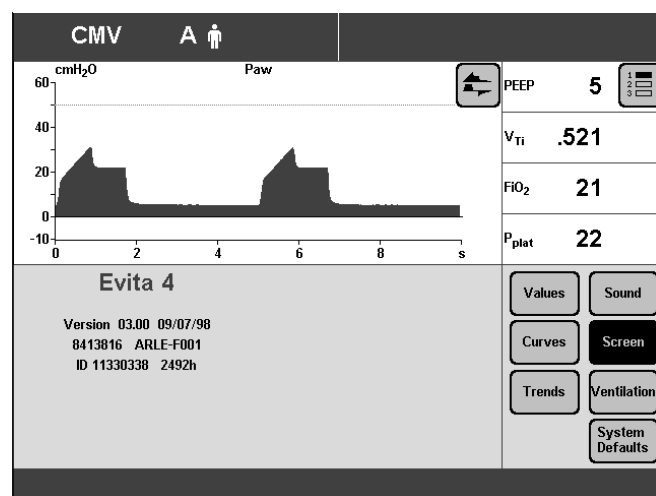
### Selecting Measured Values to be Displayed

Evita 4 displays a group of 4 measured values in the right-hand field of each screen page.

A second or third group can be displayed by touching the »« key. These parameter groups are assembled in the configuration page.

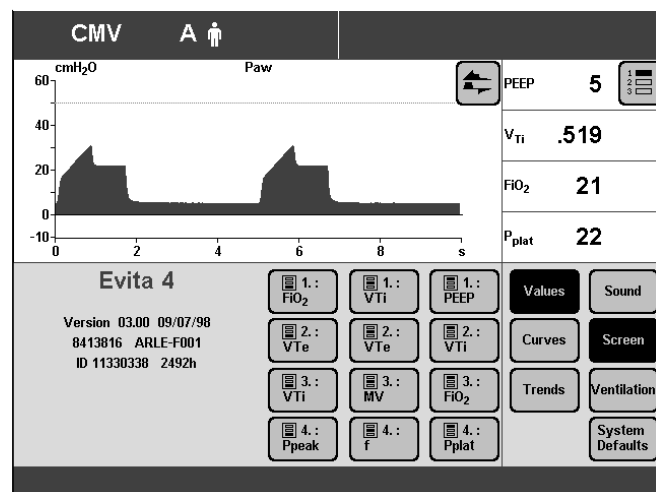
- Press »**Configuration**« key.
- Touch »**Screen**« screen key.

Display (example):



- Touch »**Values**« screen key.

Display (example):

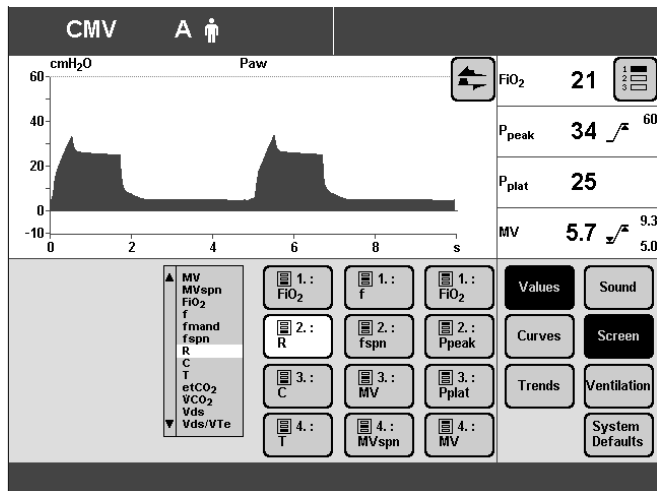


To replace one displayed measured value with another:

- Touch respective screen key.

The selection list with all available measured values is displayed next to the screen keys.

- Select the measured value to replace the old parameter,  
e.g. »R« (Resistance) by turning dial knob.
- Press dial knob to confirm selection.



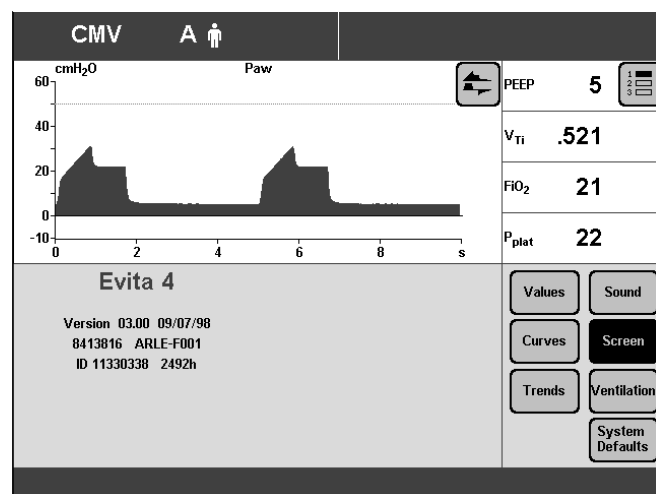


## Selecting Waveforms to be Displayed

This function serves to configure the two waveforms displayed on the standard page.

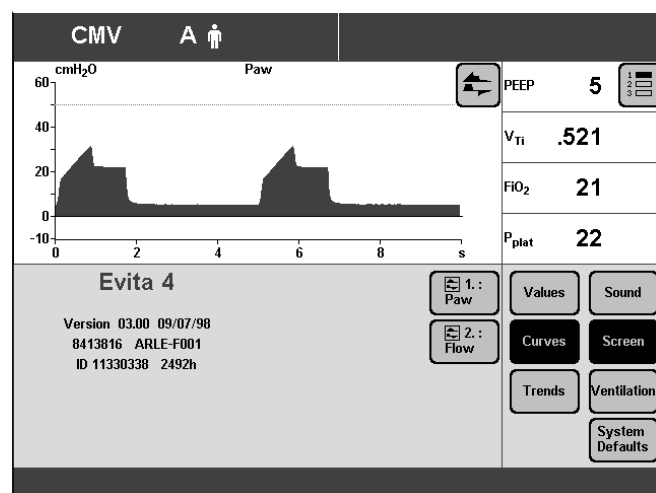
- Press »**Configuration**« key.
- Touch »**Screen**« screen key.

Display (example):



- Touch »**Curves**« screen key.

Display (example):



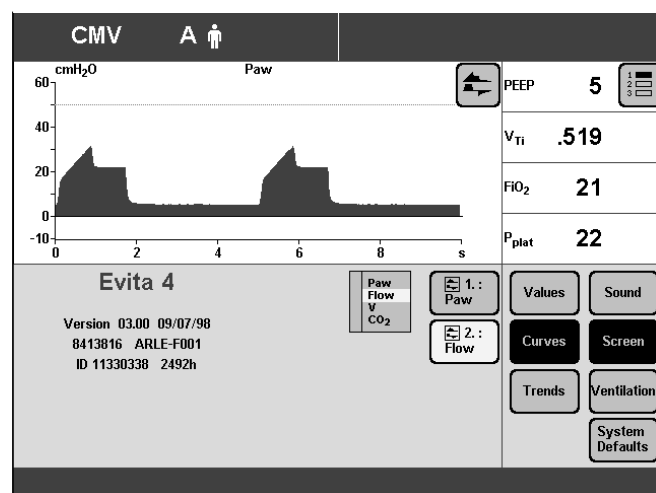
To replace one displayed waveform with another:

- Touch respective screen key.

Display (example »**Flow**«):

The selection list containing all waveforms available is displayed next to the screen keys.

- Turn dial knob for choosing a waveform to replace the current selection.
- Press dial knob to confirm selection.

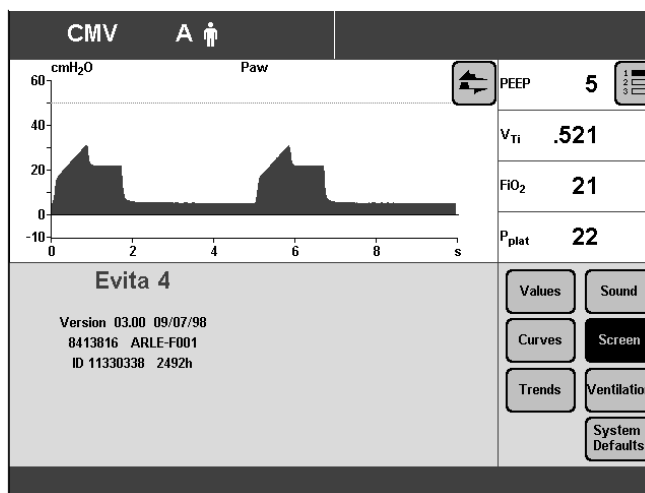


## Selecting Trends to be Displayed

This function serves to select 8 measured parameters that Evita 4 stores as trends.

- Press »**Configuration**« key.
- Touch »**Screen**« key.

Display (example):

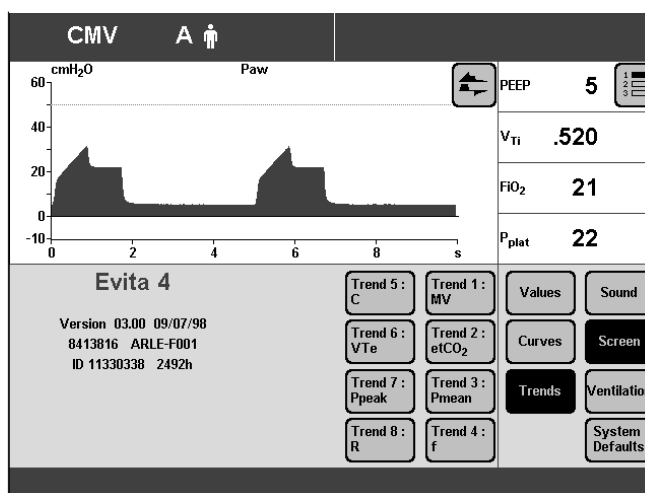


- Touch »**Trends**« screen key.

Display (example):

Available parameters to be trended are:

MV, VT<sub>e</sub>, f, FIO<sub>2</sub>, P<sub>peak</sub>, P<sub>mean</sub>, PEEP, R, C, P0.1, PEEP<sub>i</sub>, V<sub>trap</sub>, V<sub>ds</sub>, VCO<sub>2</sub>, etCO<sub>2</sub>, VTP.s., RSBi



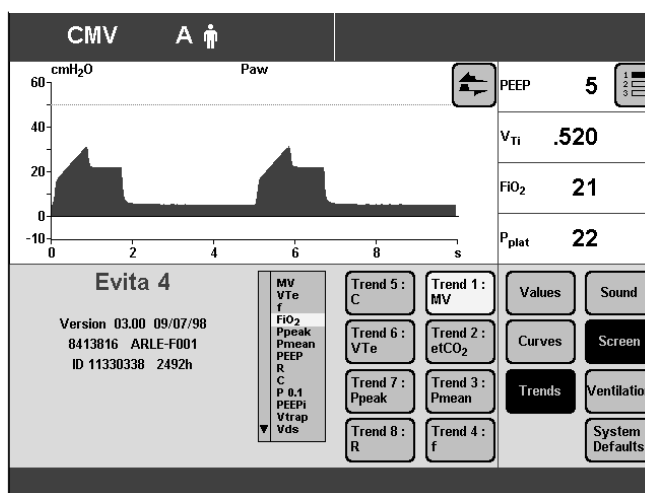
To replace one displayed trend with another:

- Touch respective screen key.

Display (example: »**Trend 1: MV**«):

The selection list containing all measured values available is displayed next to the screen keys.

- Choose measured value to replace current selection, e.g. »**FIO<sub>2</sub>**« for the trend display = turn dial knob.
- Confirm selection = press dial knob.



## Ventilation

- To select the available ventilation modes for »Settings« screen page and to select the startup ventilation mode
- To select patient mode to be active when the ventilator is switched on
- To set the ventilation parameters and alarm limits to be active when the ventilator is switched on

The configuration menu for the ventilation criteria can only be opened after entering access code 3032. This precaution is intended to prevent unauthorized modifications to the ventilation criteria.

### WARNING !

Configuration of ventilation modes and default parameters should only be performed by staff authorized by a hospital protocol.

## Selecting Ventilation Modes

To select the ventilation modes on »Settings« screen page.

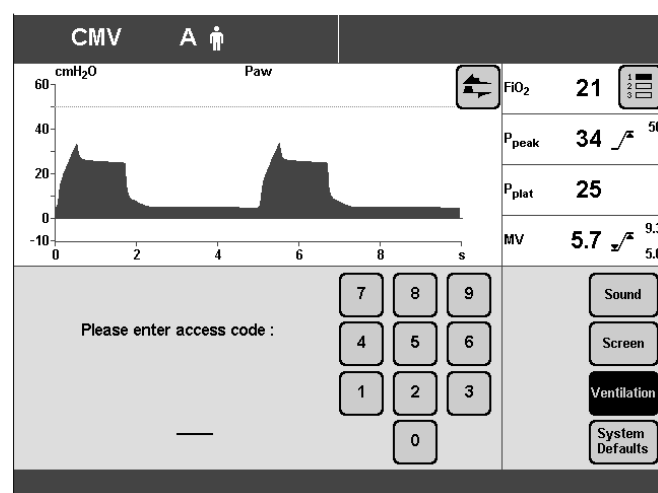
- Press »Configuration« key.

Display:

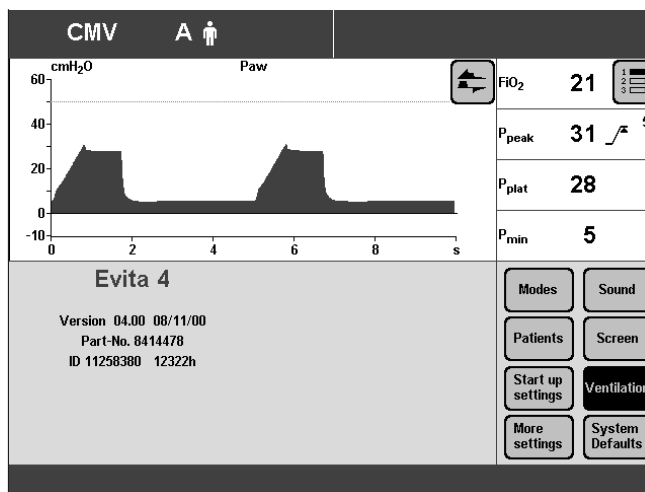
- Touch »Ventilation« screen key.

Enter access code **3032**:

- Touch respective screen keys.



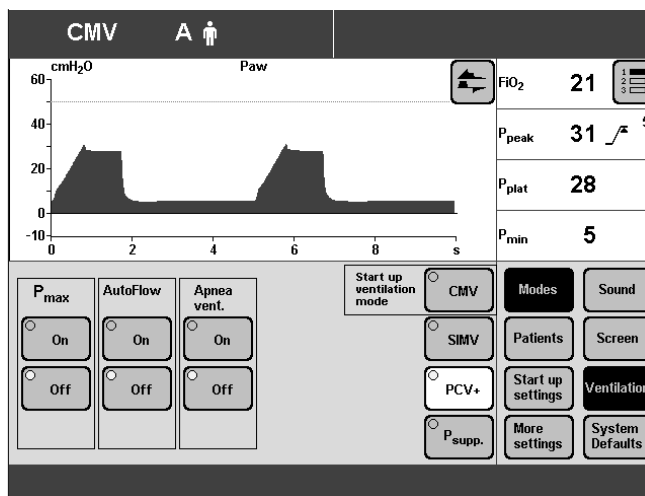
Display (example):



- Touch »Modes« screen key.

Display (example):

The ventilation mode displayed in the top screen key is the factory-set default ventilation mode (in this example: »CMV«). Evita 4 starts with this ventilation mode immediately after being switched on.



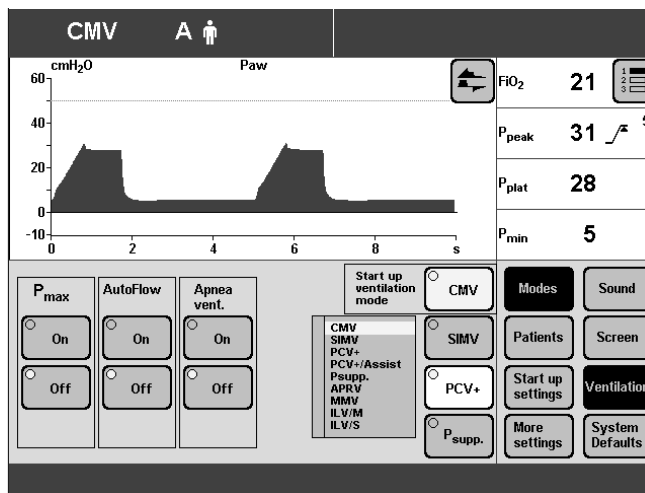
To replace the displayed startup ventilation mode by another:

- Press respective screen key.

Display (example »SIMV«):

The selection list with all available ventilation modes is displayed next to the screen keys.

- Turn dial knob to select another mode.
- Press dial knob to confirm selection.



## Selecting P<sub>max</sub> Pressure Limit

- This function serves to limit the ventilation pressure in ventilation modes CMV, SIMV, MMV.

- Press »Configuration« key.

Display (example):

- Touch »Ventilation« screen key.

Enter access code **3032**:

- Touch respective screen keys.

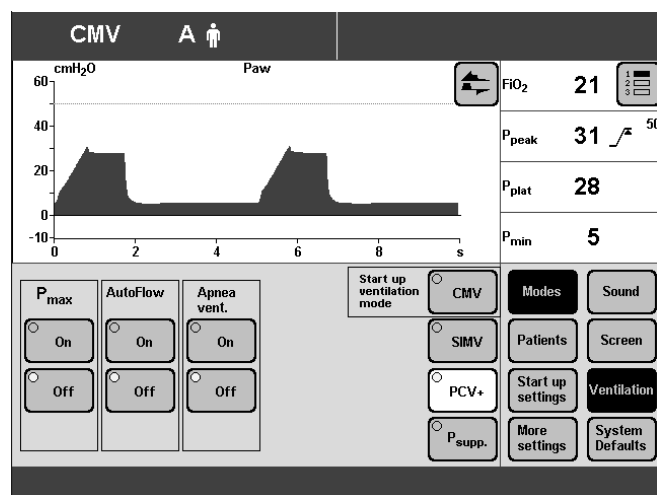
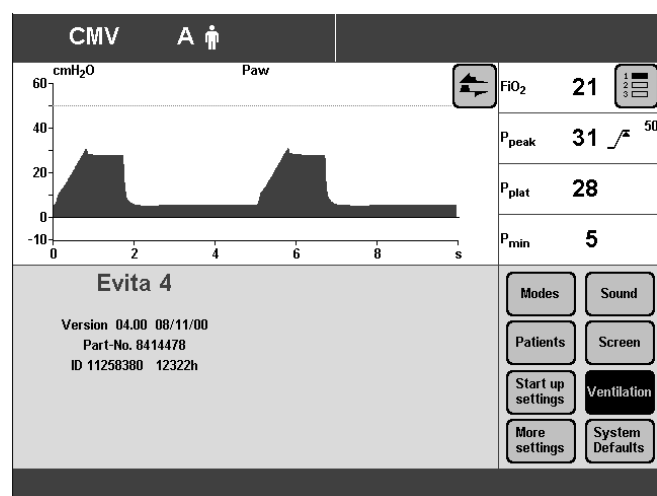
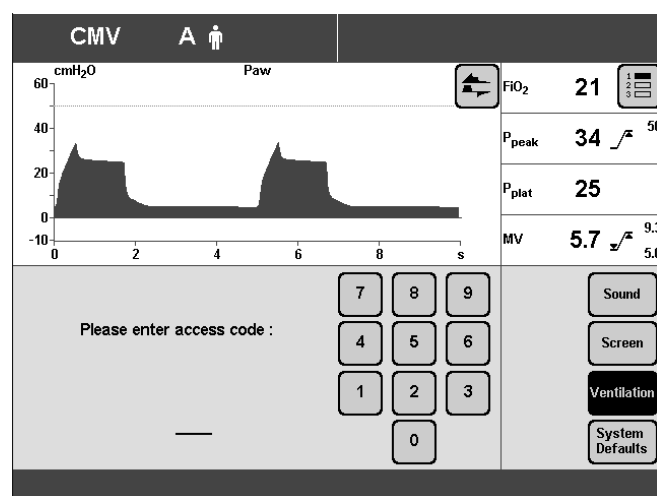
Display (example):

- Touch »Modes« screen key.

Display (example):

- Touch screen key P<sub>max</sub> »On«.
- Press dial knob to confirm selection.  
P<sub>max</sub> pressure limiting is selected.

The »P<sub>max</sub>« screen knob is now displayed on the »Settings« screen page.



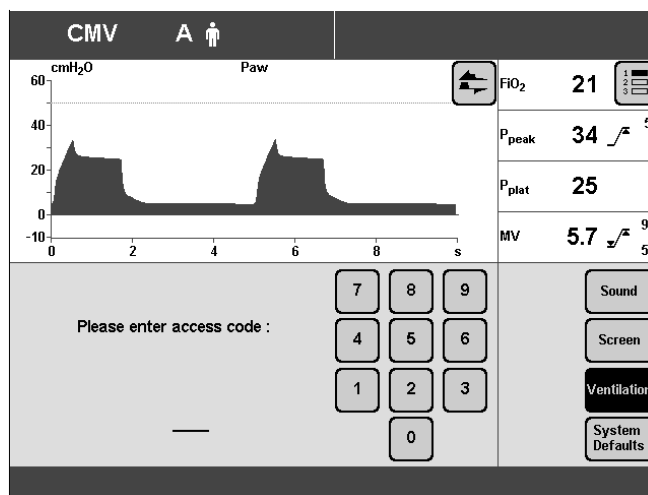
## Selecting AutoFlow® as Default Option at Startup

- To make AutoFlow® automatically active when ventilator is switched on

You can select whether the ventilator should default to using the AutoFlow® ventilation mode extension or not at startup.

- Press »**Configuration**« key.
- Touch »**Ventilation**« screen key.

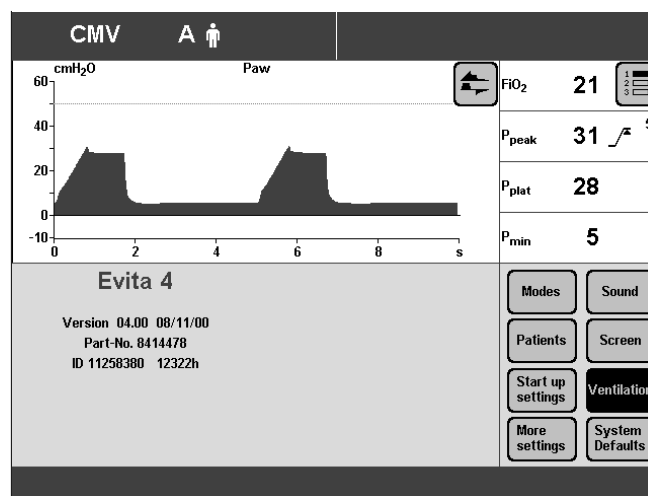
Display (example):



Enter access code **3032**:

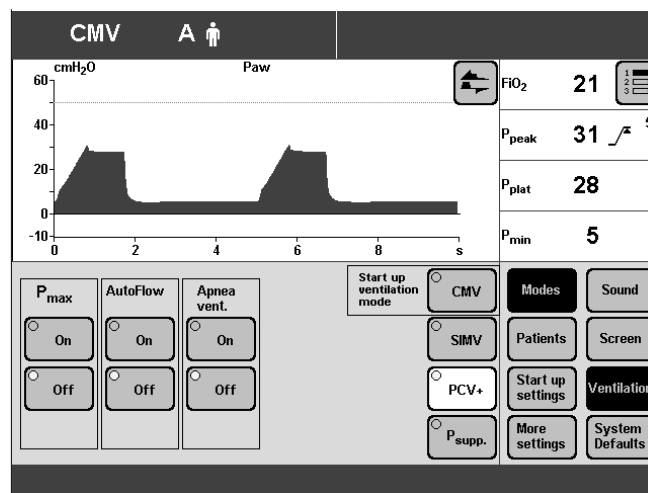
- Touch respective screen keys

Display (example):



- Touch »**Modes**« screen key.

Display (example):



To make AutoFlow® the default at startup:

- Touch AutoFlow "On" screen key.
- Press dial knob to confirm selection.  
The yellow "LED" in the screen key is now lit.

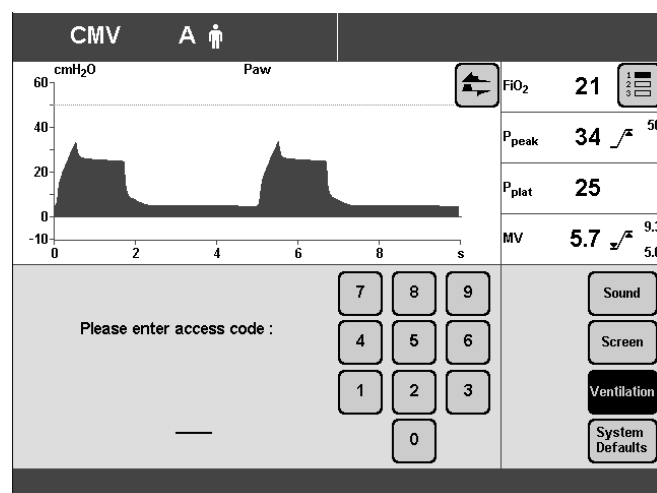
The next time the ventilator is switched on, the AutoFlow® ventilation mode extension is automatically switched on

## Apnea Ventilation On/Off

- To select whether apnea ventilation should be enabled at startup.

- Press »**Configuration**« key.
- Touch »**Ventilation**« screen key.

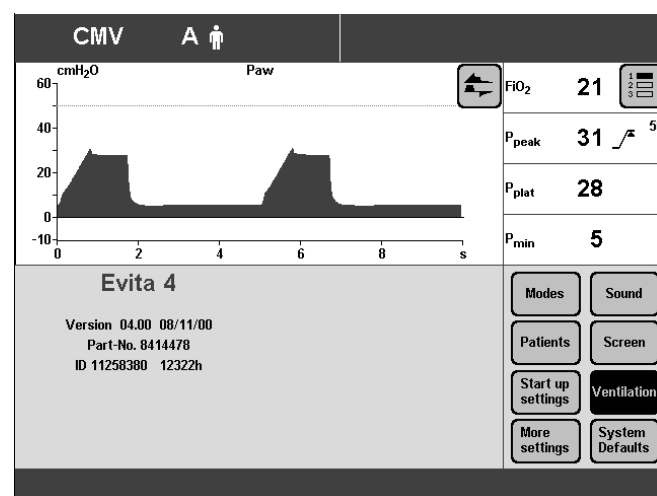
Display (example):



Enter access code **3032**:

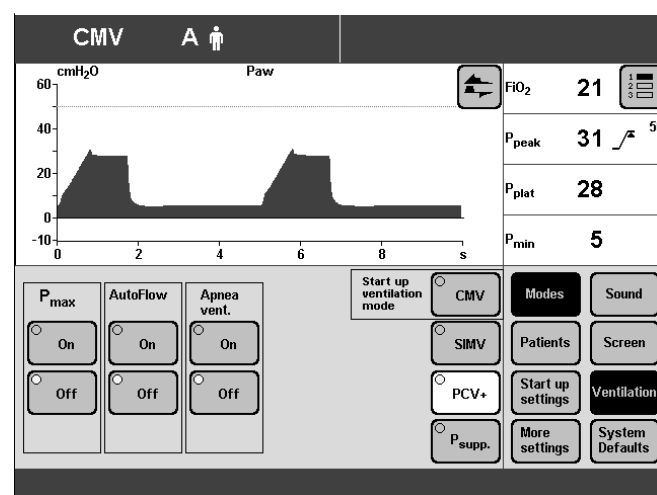
- Touch respective screen keys

Display (example):



- Touch »**Modes**« screen key.

Display (example):



To have apnea ventilation ready at startup:

- Touch Apnea vent. "On" screen key.
  - Press dial knob to confirm selection.
- The yellow "LED" in the screen key is now lit.

The next time the ventilator is switched on, the apnea ventilation mode extension is automatically enabled

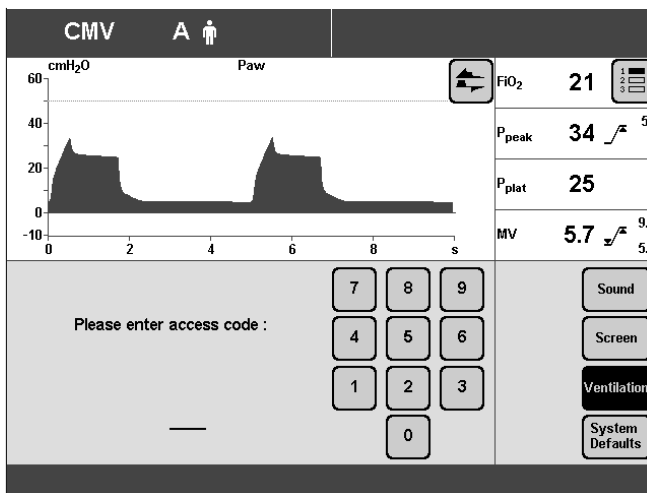
### Selecting Patient Mode

Adult/Pediatric

- To select the patient mode to be automatically activated when ventilator is switched on, or
- to select whether the ventilator should first ask for the patient mode.

- Press »**Configuration**« key.
- Touch »**Ventilation**« screen key.

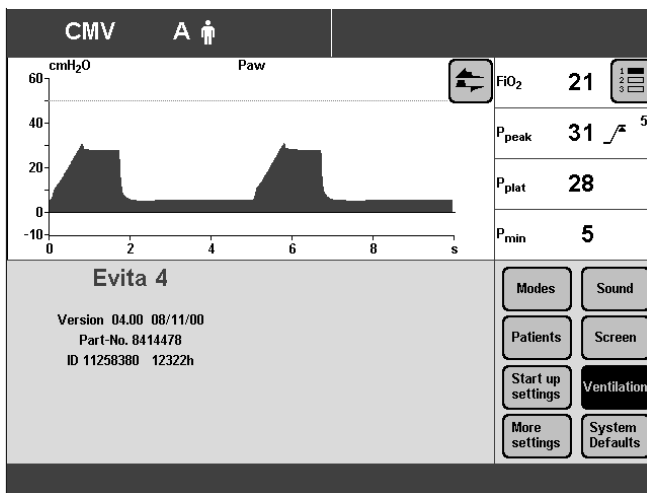
Display (example):



Enter access code **3032**:

- Touch respective screen keys.

Display (example):

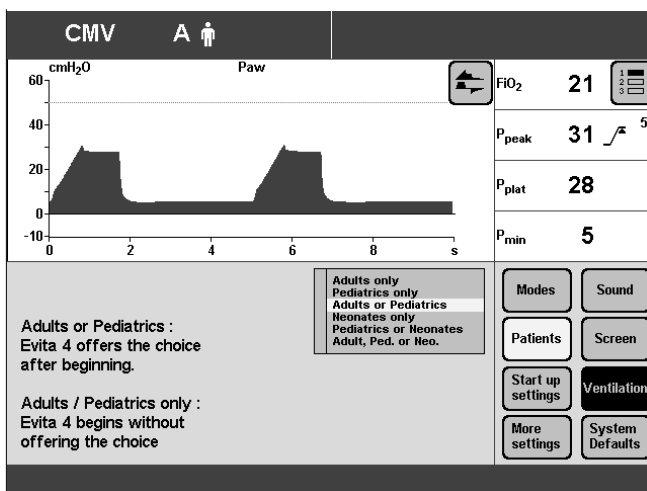


- Touch »**Patients**« screen key.

Display (example):

The selection list with the available patient mode options appears next to the screen keys.

- Turn dial knob to select the desired patient mode.
- Press dial knob to confirm the patient mode.





## Startup Defaults for Ventilation Parameters and Alarm Limits

- To set ventilation parameters and alarm limits to be activated when ventilator is switched on

## Setting Startup Values for Ventilation Parameters »VT, f«

startup values for tidal volume (VT) and breath rate (f) are determined by Evita 4 as required for the patient:

either as a function of the ideal body weight

or

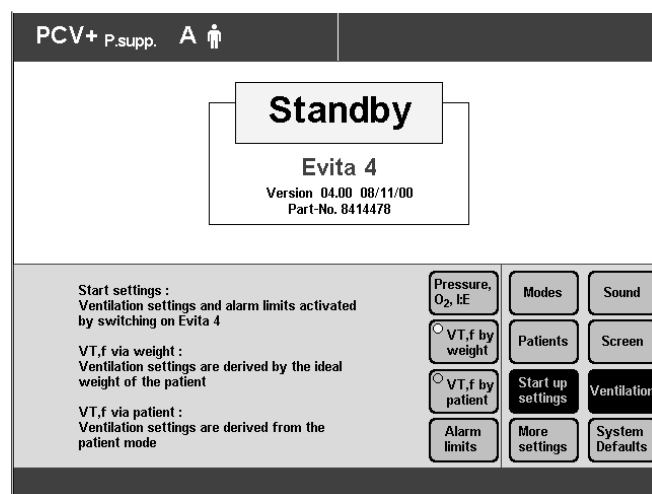
as a function of the patient mode  
(pediatrics or adult).

- Press »**Configuration**« key.
- Touch »**Ventilation**« screen key.

Enter access code **3032**:

- Touch respective screen keys.
- Touch »**Start up settings**« screen key.

Display (example):



To have the ventilator determine startup values for ventilation parameters VT, f on the basis of ideal body weight:

- Touch screen key »**VT, f by weight**« and confirm with the dial knob.

To have the ventilator determine startup values of the ventilation parameters VT, f on the basis of patient mode:

- Touch screen key »**VT, f by patient**« and confirm with dial knob.

## Configuration

### Ventilation

Startup values »VT, f« as a function of ideal body weight.  
The values are selected with reference to the Radford nomogram:

Weight kg	Factory settings		Hospital-specific settings	
	Tidal volume VT mL	Ventilator rate f bpm	Tidal volume VT mL	Ventilator rate f bpm
3	20	30	.....	.....
15	110	26	.....	.....
65	450	13	.....	.....
100	700	10	.....	.....

**NOTE:** Hospital-selected default values may be entered for reference into the spaces provided in above table.

Startup values »VT, f« as a function of patient mode.

Patient mode	Factory settings		Hospital-specific settings	
	Tidal volume VT mL	Ventilator rate f bpm	Tidal volume VT mL	Ventilator rate f bpm
Pediatric	50	29	.....	.....
Adults	500	12	.....	.....

**NOTE:** Hospital-selected default values may be entered for reference into the spaces provided in above table.

To change the startup values of »VT, f«:

- Touch screen key of the parameter to be changed.
- Turn dial knob to change value.
- Press dial knob to confirm value.

If you wish to return to the factory default settings:

- Touch »Dräger Reset« screen key.

The screenshot shows the Evita 4 ventilator interface. At the top, it displays 'PCV+ P.supp. A' with a person icon. The main display area shows 'Standby' in a large box, with 'Evita 4' and 'Version 04.00 08/11/00 Part-No. 8414478' below it. The bottom section contains a grid of settings and controls:

Wt: 0.5 kg	VT .003 L	f 30 bpm	<input checked="" type="radio"/> VT, f by weight <input type="radio"/> VT, f by patient	Pressure, O <sub>2</sub> , IE	Modes	Sound
Wt: 15 kg	VT .110 L	f 26 bpm		Patients	Screen	
Wt: 65 kg	VT .450 L	f 13 bpm		Start up settings	Ventilation	
Wt: 100 kg	VT .700 L	f 10 bpm		Dräger Reset	Alarm limits	More settings

## Setting Startup Values for Ventilation Parameters »Pressure, O<sub>2</sub>, I:E«

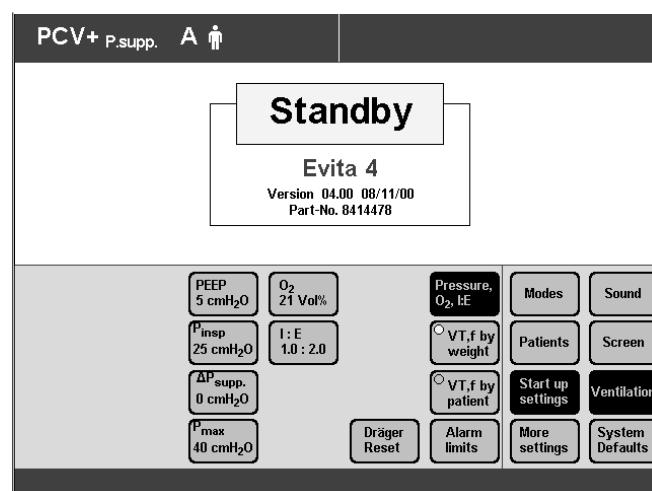
- Press »Configuration« key.
- Touch »Ventilation« screen key.

Enter access code **3032**:

- Touch respective screen keys.
- Touch »Start up settings« screen key.

Display (example):

- Touch »Pressure, O<sub>2</sub>, I:E« screen key.



Startup default values of »Pressure, O<sub>2</sub>, I:E«

	PEEP cmH <sub>2</sub> O	P <sub>insp</sub> cmH <sub>2</sub> O	ΔP <sub>Supp.</sub> <sup>1)</sup> cmH <sub>2</sub> O	P <sub>max</sub> cmH <sub>2</sub> O	O <sub>2</sub> Vol. %	I:E
Factory settings	5	15	0	40	30	1:2
Hospital-specific settings	.....	.....	.....	.....	.....	.....

1) ΔP<sub>Supp.</sub> = P<sub>Supp.</sub> - PEEP

**NOTE:** Hospital-selected default values may be entered for reference into the spaces provided in above table.

To change the startup values of »Pressure, O<sub>2</sub>, I:E«:

- Touch the screen key for the parameter to be changed.
- Turn dial knob to change value.
- Press dial knob to confirm value.

#### Leak Compensation On/Off

Using the automatic leak compensation, the ventilator will compensate leaks of up to 100% of the set tidal volume in all volume controlled ventilation modes.

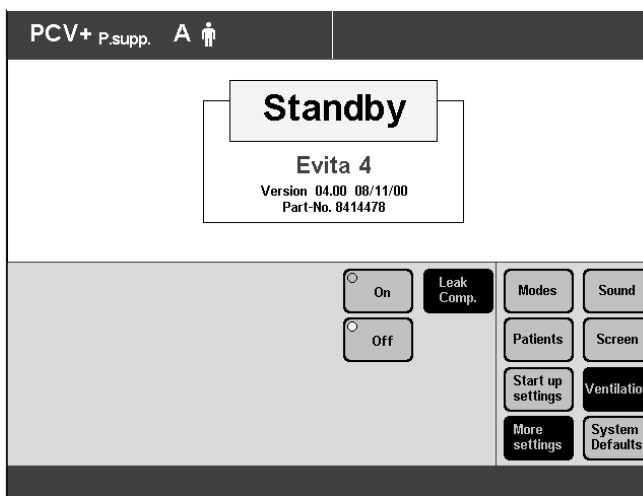
The selection "Leak compensation On/Off" will remain stored and effective upon restarting the ventilator.

- Press »**Configuration**« key.
- Touch »**Ventilation**« screen key.

Enter the access code 3032:

- Touch respective screen keys.
- Touch »**More settings**« screen key.

Display (example):



- Touch »**Leak Comp.**« screen key.
- Touch »**On**« or »**Off**« screen key.
- Press dial knob to confirm.  
The selected key is marked with a yellow LED.

1) For a detailed description of leak compensation, see "Theory of Operation", page 191.

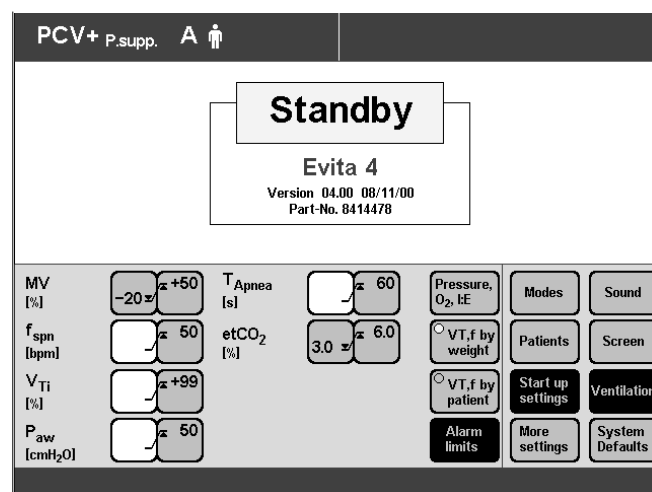
## Setting Startup Values for the Alarm Limits

- Press »**Configuration**« key.
- Touch »**Ventilation**« screen key.

Enter the access code 3032:

- Touch respective screen keys.
- Touch »**Start up settings**« screen key.
- Touch »**Alarm limits**« screen key.

Display (example):



Startup values of the alarm limits:

Alarm limit	Factory settings	Hospital-specific settings
Paw high [cmH <sub>2</sub> O]	50	.....
MV low [L/min]	(VT • f) -20 %	.....
MV high [L/min]	(VT • f) +50 %	.....
VT high [L]	VT +100 %	.....
etCO <sub>2</sub> low [mmHg]	30	.....
etCO <sub>2</sub> high [mmHg]	60	.....
f <sub>spon</sub> [1/min]	50	.....
T <sub>apnea</sub> [s]	15	.....

**NOTE:** Hospital-selected default values may be entered for reference into the spaces provided in above table.

To change default values of the alarm limits:

- Touch screen key of the alarm limit you wish to change.
- Turn dial knob to change value.
- Press dial knob to confirm value.

## System Defaults

### Configuring the External Interface

Evita 4 offers the following interface protocols:

- Printer
  - MEDIBUS (Dräger communications protocol for medical equipment)
  - LUST (list-driven universal interface driver program, compatible with the Evita RS 232 interface as of software version 7.n)
- Press »**Configuration**« key.
  - Touch »**System Defaults**« screen key.
  - Select the desired port with screen keys »**COM1**«, »**COM2**«, »**COM3**«  
(COM2 and COM3 are provided with the optional communications kit, part no. 84 11 735).
  - Select the desired interface protocol with screen keys »**Printer**«, »**MEDIBUS**« and »**LUST**«
  - Display (example):

Select the interface parameters for the selected interface protocol:

- Touch the screen key for the parameter, e.g. »**Baud rate**«
- Turn dial knob to change value.
- Press dial knob to confirm value

For MEDIBUS protocol:

- Baud rate
- Parity check bits (see Operating Manual of the connected device)
- Number of stop bits (see Operating Manual of the connected device)

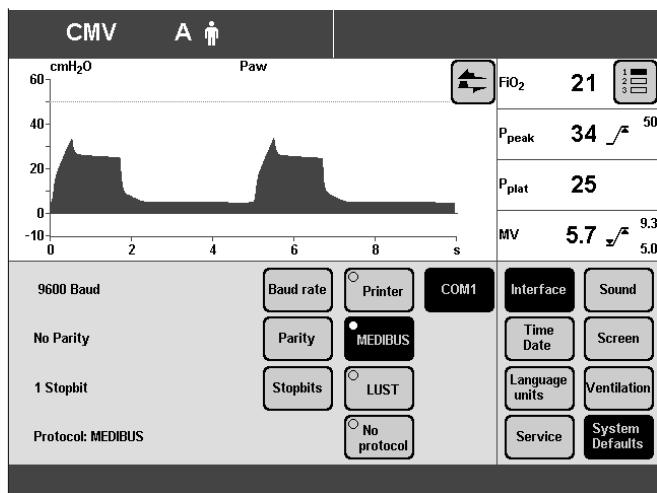
For LUST protocol:

- Baud rate

For printer protocol:

- Baud rate (see Operating Manual of the printer).
- Print interval (set in accordance with hospital protocol requirement for documentation)

Used for connecting a printer to Evita 4 (HP Deskjet 500 and compatible printers with serial interface).



Prints all important data from Evita 4 and also all settings that have changed since the last printout in an adjustable time interval (0 to 60 minutes). If the time interval set to zero, no printout is performed.

Alarms are printed as they are generated by alarm conditions and are independent from the set print interval.

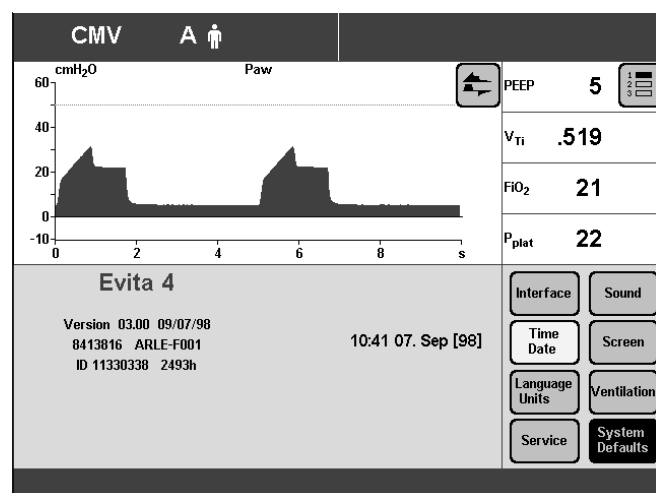
In addition, a printout can be triggered by pressing the »Printer« function key. This will not affect the running print interval.

## Setting Time and Date

- Press »Configuration« key.
- Touch »Defaults« screen key, and
- touch »Time Date« screen key.

Display (example):

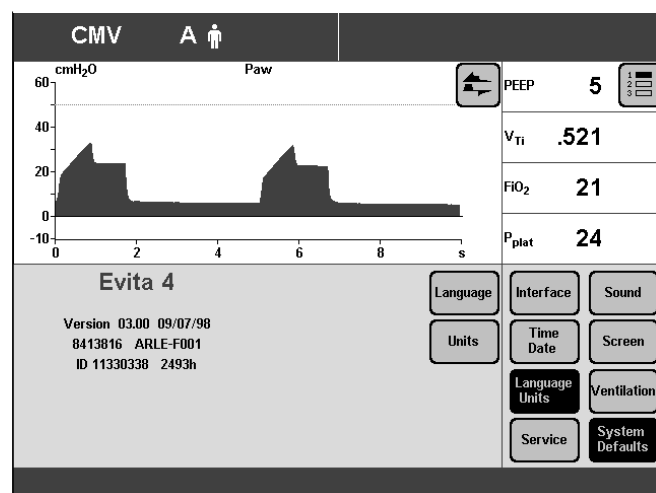
- Turn dial knob to change value in bracket cursor (Example [98]).
- Press dial knob to confirm value.



## Selecting Language and Units of Measurement

- To select the desired language for all screen texts
- To select the units for pressure,  $\text{CO}_2$  concentration, and temperature.
- Press »Configuration« key.
- Touch »Defaults« screen key.
- Touch »Language/Units« screen key.

Display (example):



## Configuration

### System Defaults

Select language:

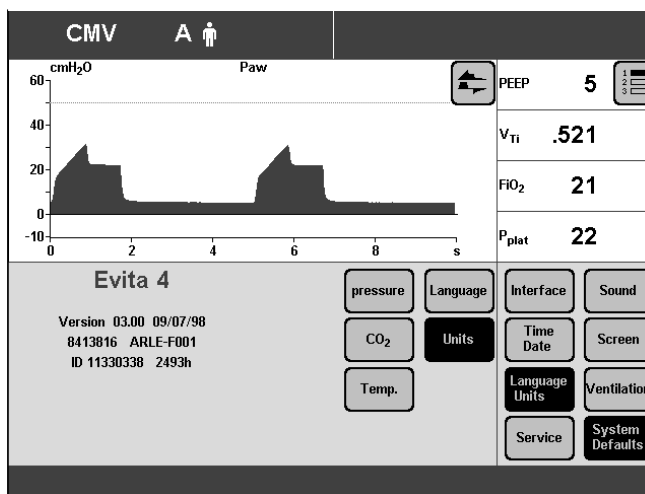
- Touch »**Language**« screen key.
- Turn dial knob to select language.
- Press dial knob to confirm language.

Select unit of measurement:

- Touch »**Units**« screen key.

Display (example):

- Touch respective screen key.
- Turn dial knob to select unit.
- Press dial knob to confirm unit selection.



## Service Diagnostics

For a description, please refer to Evita 4 Servicing Documentation available to technicians trained by DraegerService.

### WARNING !

Diagnostic procedures on the Evita 4 ventilator should be performed by factory trained and authorized service personnel only.



## Care

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## Dismantling

Clean and process ventilator after each patient.

Recommendation:

Change the hose system and expiration valve every 24 hours. Keep the replacement systems ready.

### WARNING !

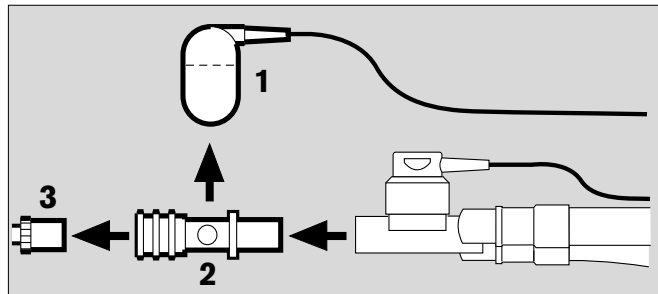
To avoid endangering hospital staff and other patients, the ventilator must be disinfected and cleaned whenever it has been used. Follow accepted hospital procedures for disinfecting contaminated parts (protective clothing, eyewear, etc.).

### Removing Components

- Switch off both ventilator and humidifier, and remove their power plugs.
- Drain water traps and patient circuit.
- Drain the water container of the humidifier.

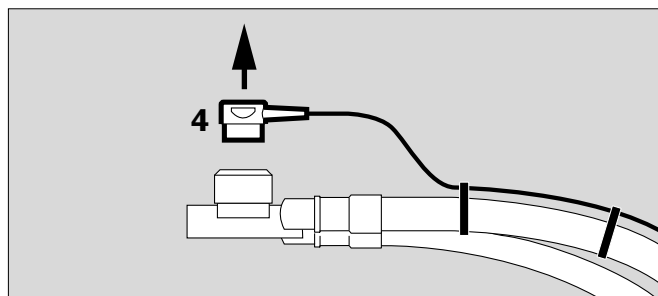
#### CO<sub>2</sub> sensor (available option)

- 1 Remove CO<sub>2</sub> sensor from its cuvette. Unplug sensor in the rear of the Evita 4 ventilator
- 2 Remove CO<sub>2</sub> sensor cuvette from Y-piece.
- 3 Remove ET-tube connector from cuvette.



#### Temperature sensor

- 4 Remove temperature sensor from Y-piece – or from its receptacle on the reusable pediatric circuit. Do not pull on cable.
- Unplug sensor probe in the rear of the Evita 4 ventilator.
  - Prepare temperature sensor for wipe disinfection.

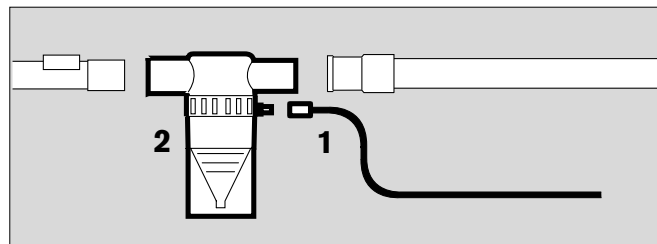


### CAUTION !

The temperature sensor is not designed for disinfection in an automatic parts washer or for bath disinfection.

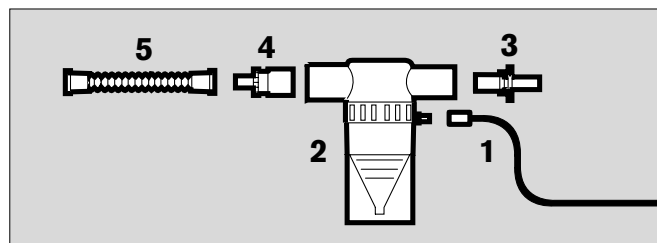
**Nebulizer (available option)**

- 1 Remove nebulizer hose from nebulizer and from its nipple in the front of Evita 4.
- 2 Remove nebulizer from patient circuit,



or (for pediatric circuit)

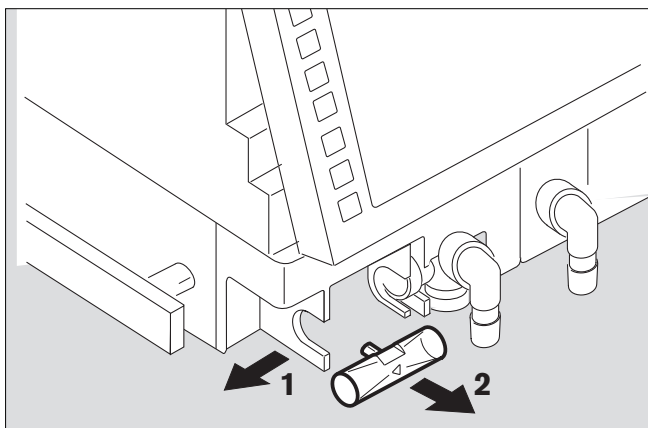
- 2 remove nebulizer from pediatric circuit.
  - 3 Remove tapered adapter (ISO Ø15 / Ø11) from nebulizer entry port.
  - 4 Remove tapered adapter (ISO Ø22/ Ø11 from nebulizer output port.
  - 5 Remove corrugated silicone circuit segment from tapered adapter.
- Disassemble nebulizer according to its respective Operating Instructions.
  - Prepare nebulizer components and adapters for disinfection and cleaning in an automatic parts washer.

**Ventilation circuit**

- Remove patient circuit from connection ports.
- For reusable circuits, remove Y-piece and water traps from circuit and collecting jars from water traps.
- For reusable circuits, prepare circuit segments, water traps and their collecting jars, and the Y-piece for disinfection and cleaning in an automatic parts washer.

### Flow sensor

- Tilt control panel upwards.
- 1 Push flow sensor to left as far as it will go and
  - 2 pull out.



### CAUTION !

The flow sensor is not autoclavable and is not designed for disinfection in an automatic parts washer.

- Disinfect flow sensor for about 1 hour in 70% ethanol solution.

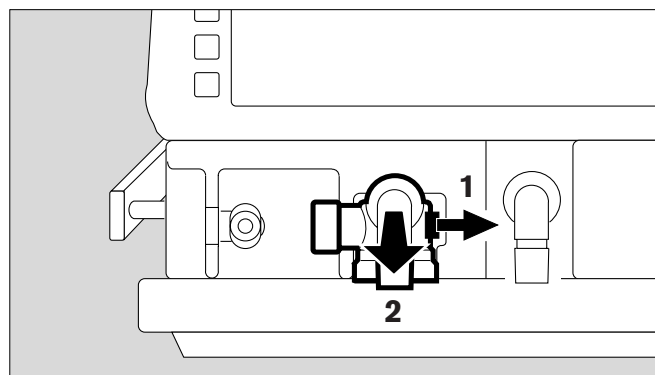
### WARNING !

Allow flow sensor to air for at least 30 minutes after bath disinfection in alcohol. Otherwise, residual alcohol vapor and increased heat energy during calibration could result in combustion and destroy sensor.

**NOTE:** The flow sensor may be reused as long as it can be calibrated successfully.

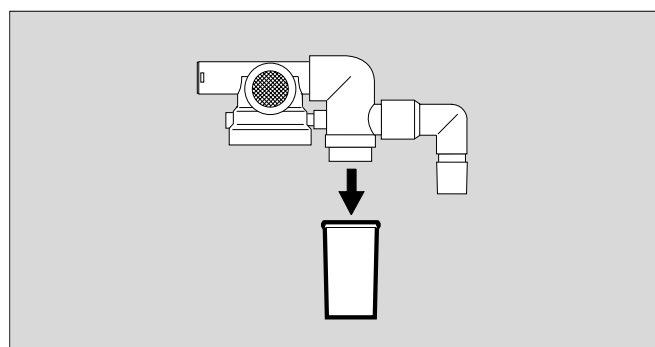
**Expiratory valve**

- Push catch to right, pulling off expiratory valve at the same time.



If the expiratory valve is equipped with an optional water trap:

- Remove collecting jar.



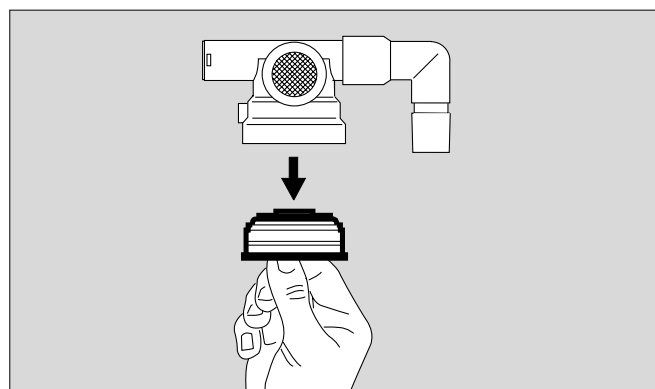
Disassemble expiratory valve only if badly soiled:

- Unscrew cover lid by hand and remove together with the diaphragm.

**CAUTION !**

Do not disassemble expiratory valve beyond removing diaphragm!

- Prepare expiratory valve for disinfection and cleaning in an automatic parts washer, and
- prepare for autoclaving.
- Always place opened expiratory valve in disinfection or autoclave trays so it will not be damaged by other parts.

**Humidifier**

- Disassemble according to its respective Operating Instructions and prepare for disinfection/sterilization.

## Disinfecting/Cleaning

### CAUTION !

Certain components of the ventilator consist of materials that are sensitive to certain organic solvents sometimes used for cleaning and disinfecting (e.g., compounds containing alkylamine, phenols, halogen or oxygen releasing compounds, strong organic acids, etc.). Exposure to such substances may cause damage that is not always immediately recognized. Sterilization with ethylene oxide (EtO) is also not recommended.

### CAUTION !

The screen of the ventilator control panel is made of Plexiglas® (polyacrylate). Do not clean or disinfect with agents containing alcohol as this might cause fissures in the material.

To prevent any damage, we recommend that only detergents and disinfectants are used that are compatible with the device, e.g. surface disinfectants on the basis of aldehydes or quarternary ammonium compounds for disinfection.

Ensure that all disinfectants are registered with the U.S. Environmental Protection Agency for use as intended. Always follow the instruction labels specifically with respect to prescribed concentrations and the necessary exposure times

Disinfectants often contain – besides their main active agents – additives that can also damage materials. If in doubt, ask the supplier/manufacturer of the disinfectant/cleaning agent.

For a list of materials used in the ventilator, see page 177.

### WARNING !

**To avoid endangering hospital staff and other patients, the ventilator must be disinfected and cleaned whenever it has been used. Follow accepted hospital procedures for disinfecting contaminated parts (protective clothing, eyewear, etc.).**

### Ventilator Without Circuits, Gas Supply Hoses and Temperature Sensor

- Wipe disinfect with a disinfectant based on the suggested active ingredients.  
Make sure to comply with manufacturer's instructions.

### Cooling air filter, room air filter

- Filters must be cleaned or replaced when soiled or at the latest after 4 weeks, see page 152.

### CO<sub>2</sub> Cuvette

- Wipe off any soiling with disposable tissue and cotton swabs, particularly the inside and outside of the cuvette windows.
- Disinfect in a moisture saturated environment at 93 °C (200 °F) for 10 minutes using a cleaning and disinfecting machine. **Use detergent only.**

Or:

- Bath disinfect using a disinfectant based on the suggested active substances, e.g. Cidex, Johnson & Johnson

Or:

- Autoclave at 134 °C (273 °F).

### CO<sub>2</sub> Sensor

- Wipe off any soiling with cotton swabs, in particular on the windows of the CO<sub>2</sub> sensor.
- Wipe-disinfect, e.g. with 70% ethanol.

### Components of Reusable Patient Circuit and Expiratory Valve (or, in the event of severe soiling, its disassembled components)

- Disinfect in a moisture saturated environment at 93 °C (200 °F) for 10 minutes using a cleaning and disinfecting machine. **Use detergent only.**
- After disinfecting with moist heat, we recommend that the **expiratory valve or its disassembled components be autoclaved at 134 °C (273 °F) to remove any remaining liquid.**

#### CAUTION !

Make certain that no liquid remains in the pressure measuring canal of the expiratory valve, as it might cause malfunction.

Alternatively, if no parts washer is available:

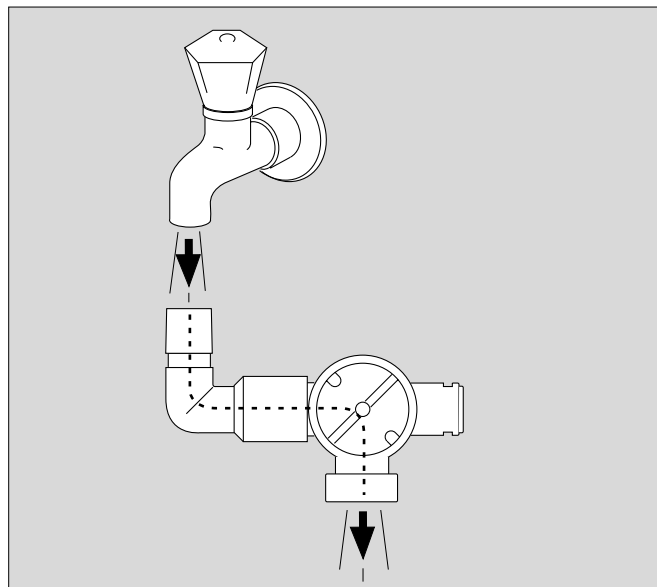
- **Bath disinfect** using a disinfectant based on the recommended agents.  
Make certain to comply with manufacturer's instructions.  
  
Rinse with clean water, preferably from a demineralized water supply. Shake water out thoroughly, and leave parts to dry.
- After bath disinfection, we recommend that the **expiratory valve or its disassembled components be autoclaved at 134 °C (273 °F) to remove any remaining liquid.**

#### CAUTION !

Make certain that no liquid remains in the pressure measuring canal of the expiratory valve, as it might cause malfunction.

Alternatively (**expiratory valve**)

- Rinse thoroughly with clear water, preferably from a demineralized water supply.  
Shake water out thoroughly.
- After rinsing thoroughly, dry expiratory valve.
- After drying, autoclave at 134 °C (273 °F)





**CAUTION !**

Make certain that no liquid remains in the pressure measuring canal of the expiratory valve, as it might cause malfunction.

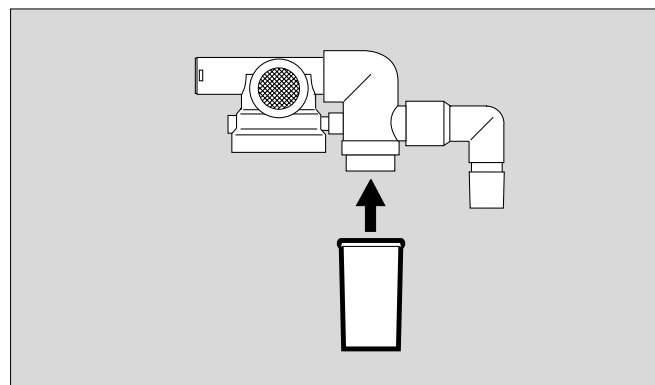
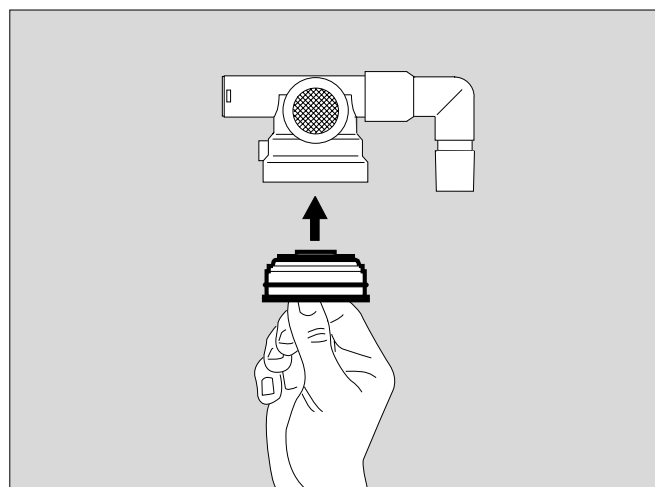
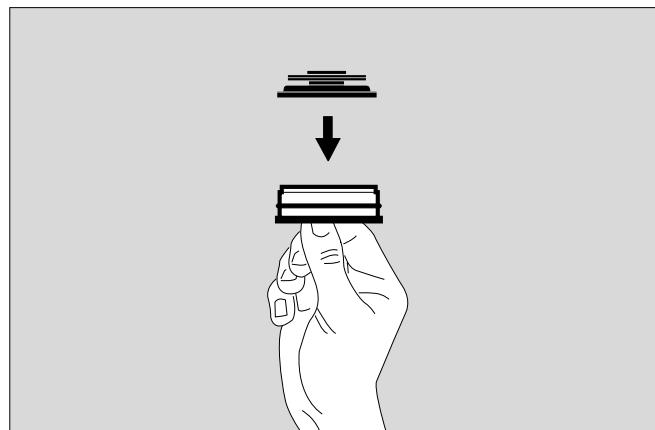
**NOTE:** Reusable (silicone) patient circuit, water traps and their collecting jars, Y-piece, expiratory valve, temperature sensor may all be autoclaved at 134 °C (273 °F).

## Assembling

### Assembling the Expiratory Valve

Parts must be entirely dry to prevent malfunctioning.

- Hold cover lid by its flange and place diaphragm on the collar of the lid.  
Be careful to fit the diaphragm properly.
- Insert lid with diaphragm on top into the housing from below and screw in tightly.



If the expiratory valve is equipped with the optional water trap:

- Install collecting jar.

## **Nebulizer**

- Assemble according to its Instructions for Use.
- For installation of nebulizer, see page 103.

## **Humidifier**

- Assemble according to its Instructions for Use.

## **Before Reusing on a Patient**

- Fully assemble ventilator as described under "Preparation", page 42.
- Perform all checks of readiness for operation, see "Ventilator Checks" on page 58.

## Maintenance

### CAUTION !

#### Maintenance

The device must be inspected and serviced at regular 6 month intervals. A record must be kept on this preventive maintenance. We recommend obtaining a service contract with DraegerService through your vendor.

For repairs and in any case of malfunction of the device, we recommend that you contact DraegerService.

### WARNING !

To avoid any risk of infection, clean and disinfect ventilator and accessories before any maintenance according to established hospital procedures - this applies also when returning ventilators or parts for repair.

### WARNING !

Never operate the ventilator if it has suffered physical damage or does not seem to operate properly. In this case always refer servicing to properly trained and factory authorized service personnel.

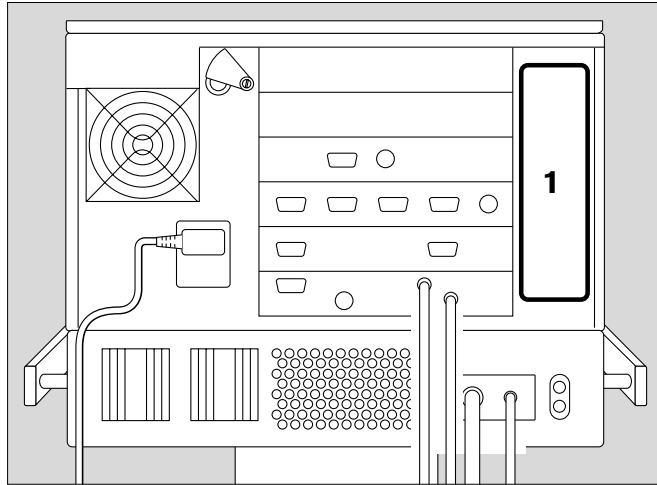
## Maintenance Intervals

O2 sensor capsule	Replace sensor capsule in the event of display message: <b>O2 measurement inop</b> or if calibration is impossible. For disposal of sensor capsule, see page 152.
Air-intake filter, Cooling-air filter	Clean or replace after 4 weeks, see page 152. Replace at least every year. May be disposed with regular domestic waste.
Filters in the compressed gas inlets	To be replaced by trained service personnel every 2 years.
Lithium battery for data backup	To be replaced by factory trained and authorized service personnel every 2 years. For disposal, see page 152.
Real-time clock	To be replaced by factory trained and authorized service personnel every 6 years.
Pressure reducer	Complete overhaul every 6 years by DraegerService.
Preventive maintenance and service	Every 6 months by factory trained and authorized service personnel.

## User-Replaceable Parts

### Clean or replace cooling air filter

- Filter must be cleaned or replaced when soiled or at the latest after 4 weeks.  
Replace after 1 year at the latest.
- 1 Remove cooling-air filter from its frame in the back of the ventilator.
- Replace or clean in warm water with detergent added; dry well.
- Insert cooling-air filter into frame, taking care not to crease it.
- Dispose of used cooling-air filter with domestic waste.



### Disposal of batteries and O<sub>2</sub> sensors

#### WARNING !

**Treatment of batteries and O<sub>2</sub> sensor capsules:**

**Do not throw into fire! Risk of explosion.**

**Do not force open! Danger of bodily injury.**

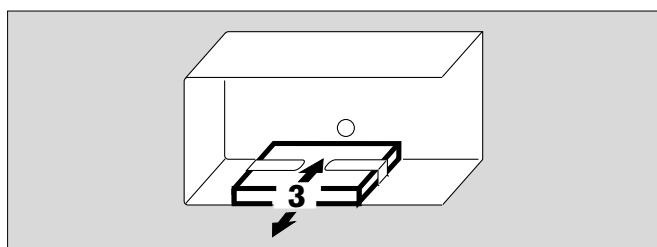
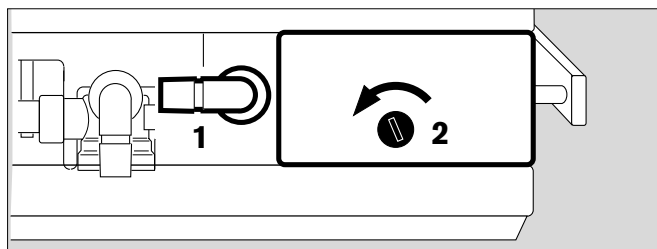
**Follow all local, state, and federal regulations with respect to environmental protection when disposing of batteries and O<sub>2</sub> sensor capsules.**

- Batteries must be disposed of as special waste.

Dispose of O<sub>2</sub> sensors in the same way as batteries. Information may be obtained from local environmental and public health authorities or from approved waste disposal companies.

### Removing/Installing air intake filter

- Filter must be cleaned or replaced when soiled or at the latest after 4 weeks.  
Replace after 1 year at the latest.
- 1 If necessary, swivel inspiratory port to the left.
- 2 Loosen screw with a coin and remove protective cover.
- 3 Remove the air intake filter from the protective cover.
- Push new air intake filter under lugs in ventilator.
- Replace protective cover and tighten screw with a coin.
- Dispose of used ambient-air filter with domestic waste.



## **Disposal of Ventilator**

- at the end of its useful life

Prepare disposal of Evita 4 by an authorized waste disposal/recycling company after consulting with local environmental and public health authorities

Follow all local, state, and federal regulations with respect to environmental protection when disposing of the ventilator.

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**Troubleshooting**

**Contents**

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# Troubleshooting

Alarm messages in the alarm display field are displayed in hierarchical order.

If, for example, two faults are detected at the same time, the more critical of the two is displayed.

The priority for alarm messages is marked by exclamation marks:

Warning = Message with top priority !!!

Caution = Message with medium priority !!

Advisory = Message with low priority !

In the table below, the messages are listed in alphabetical order.

The table should help you identify the cause of any alarm, and to ensure rapid remedy of the problem.

Message		Cause	Remedy
<b>Air supply low</b>	!!!	Air supply pressure too low.	Make sure pressure is greater than 3 bar.
<b>Air supply low</b>	!	Air supply pressure too low. Air supply pressure not required when FiO <sub>2</sub> = 100 Vol. %.	Make sure pressure is greater than 3 bar.
<b>Air supply pressure high</b>	!!	Air supply pressure too high.	Ensure pressure is less than 6 bar.
<b>Air supply pressure high</b>	!	Air supply pressure too high. Air supply is not needed for FiO <sub>2</sub> = 100 Vol. %.	Ensure pressure is less than 6 bar.
<b>Airway obstruction? !!!</b>		Evita 4 is able to only apply a very small volume with each ventilator breath, e.g. due to a blocked tube.	Check patient condition, check tube
		Patient is fighting the ventilator during pressure controlled ventilation. This results in reaching set inspiratory pressure at only a minimum tidal volume delivery.	Check patient condition. check ventilator settings.
<b>Airway pressure high</b>	!!!	The upper alarm limit for the airway pressure has been exceeded. The patient is »fighting« the ventilator, cough.	Check patient condition, Check ventilation pattern, Correct alarm limit if necessary.
<b>Airway pressure low</b>	!!!	Leaking cuff.	Inflate cuff and perform leak test.
		Leak or disconnection.	Check hose system for tight connections. Check that the expiration valve is properly engaged.
<b>Apnea</b>	!!!	Patient's spontaneous breathing has stopped.	Apply controlled ventilation.
		Stenosis	Check patient condition. Check tube.
		Flow sensor not calibrated or faulty.	Calibrate flow sensor. Replace if necessary.
<b>Apnea ventilation</b>	!!	Due to detected apnea, the system has switched over automatically to mandatory ventilation.	Check ventilation mode. To return to the original ventilation mode, press the »Alarm Reset« key. Check patient condition. Check tube.



Message		Cause	Remedy
Check settings	!!	Power interruption while setting a ventilation pattern or the alarm limits.	Check pattern of ventilation and alarm limits. Confirm message with »Alarm Reset« key.
Clean CO <sub>2</sub> cuvette	!!!	Cuvette window dirty.	Use clean cuvette.
CO <sub>2</sub> measurement inop	!!!	CO <sub>2</sub> sensor faulty.	Replace faulty CO <sub>2</sub> sensor.
		CO <sub>2</sub> measurement incorrect.	Call DraegerService.
CO <sub>2</sub> monitoring off	!	CO <sub>2</sub> monitoring is switched off.	Switch CO <sub>2</sub> monitoring back on, see page 109, or provide adequate external monitoring without delay.
CO <sub>2</sub> sensor	!!!	Probe of CO <sub>2</sub> sensor withdrawn during operation.	Reinsert probe.
		CO <sub>2</sub> sensor not positioned on cuvette.	Place CO <sub>2</sub> sensor on cuvette.
		CO <sub>2</sub> sensor faulty.	Replace defective CO <sub>2</sub> sensor.
CO <sub>2</sub> zero?	!!!	Zero outside the permitted tolerance.	Perform zero calibration, page 114.
Device failure	!!!	Device faulty.	Call DraegerService.
etCO <sub>2</sub> high	!!!	End-expiratory CO <sub>2</sub> concentration above upper alarm limit.	Check patient condition, check pattern of ventilation, correct alarm limit if necessary.
etCO <sub>2</sub> low	!!!	End-expiratory CO <sub>2</sub> concentration below lower alarm limit.	Check patient condition, check pattern of ventilation, correct alarm limit if necessary.
Evita Remote ?	!!	The remote control pad used was not recognized.	Remove remote pad. Acknowledge advisory with »Alarm Reset« key. Contact DraegerService at your earliest convenience.
Evita Remote inop.	!	A key of the remote control pad was pressed during the self test of the pad.	Acknowledge advisory with »Alarm Reset« key. Detach remote pad and reconnect. Ensure that no key is pressed on the remote control during the self test.
		Remote control pad faulty.	Acknowledge advisory with »Alarm Reset« key. Disconnect remote pad . Call DraegerService.
Execute checklist	!!	Equipment check not performed.	Perform equipment check, page 58. Confirm message with »Alarm Reset« key.
Exp. hold interrupted	!	The »Exp. hold« key was held down longer than 15 seconds.	Release »Exp. hold« key.
Exp. valve inop	!!!	Expiration valve not properly connected to socket.	Push expiration valve firmly into socket until it clicks into place.
		Flow sensor not calibrated or defective.	Calibrate flow sensor, page 112, and replace if necessary.
		Expiration valve faulty. Faulty assembly of expiration valve.	Replace expiration valve.

Message	Cause	Remedy
<b>External flow</b>	! Evita 4 is taking into account externally supplied flow when monitoring flow sensor function.	To switch external flow discounting off, see page 113.
<b>Failure to cycle</b>	!!! The device does not deliver any gas.	Check the Pmax/PEEP setting. Set an CMV frequency of at least 4/min. Increase TApnea/ alarm time.
<b>Fan failure</b>	!!! Fan failure.	Call DraegerService.
<b>Fan malfunction</b>	! Temperature in machine too high.	Check fan function, clean cooling-air filter or call DraegerService.
<b>FiO2 high</b>	!!! O2 sensor not calibrated.	Calibrate O2 sensor, page 111.
	Faulty mixer function.	Call DraegerService.
<b>FiO2 low</b>	!!! O2 sensor not calibrated.	Calibrate O2 sensor, page 111.
	Faulty mixer function.	Call DraegerService.
<b>Flow measurement inop</b>	!!! Flow sensor faulty.	Calibrate flow sensor, page 112, and replace if necessary.
	Flow measurement malfunction.	Call DraegerService.
<b>Flow monitoring off</b>	! Flow monitoring is switched off.	Switch on CO2 monitoring again, as described on page 109, or immediately ensure an adequate external monitor function.
<b>Flow sensor?</b>	!!! Flow sensor not fully inserted in rubber lip of expiration valve.	Insert flow sensor correctly.
<b>Frequency ILV Slave?</b> Message on slave device	! The frequency (breathing rate) of the master and slave devices differ by more than 12%.	Adjust the frequency of the slave device to that of the master.
<b>Hard key xx failed</b>	!! Key xx (e.g. »  « can no longer be pressed.	Call DraegerService.
<b>High frequency</b>	!!! Patient is breathing at a high spontaneous frequency	Check patient condition, Check pattern of ventilation, Correct alarm limit if necessary.
<b>ILV Sync. inop.</b> Message on both devices	!!! Frequency on master device less than 4 breaths per minute.	Set a higher frequency.
	Device defective.	Call DraegerService.
<b>Insp. hold interrupted</b>	! The »Insp. hold« key was held down longer than 15 seconds.	Release »Insp. hold« key.
<b>Key xx overused?</b>	!! Key has been pressed several times in a short period (e.g. »  «).	Confirm message with »Alarm Reset« key. If this message occurs repeatedly, call DraegerService.

Message	Cause	Remedy
<b>Key overused</b>	!! Due to very frequent key use, the screen contents of the display are repeatedly redrawn.	Acknowledge message with »Alarm Reset« key.
	Brief communication failure between the display processor and main processor.	Acknowledge message with »Alarm Reset« key. If this message occurs again, call DraegerService.
<b>Leakage</b>	! The measured leakage minute volume $MV_{leak}$ is 20% higher than the minute volume measured on the expiration side.	Check that the hose connection is leakproof. Check that the tube is correctly fitted.
<b>Loss of data</b>	!!! Lithium battery discharged.	Call DraegerService.
<b>MEDIBUS inop</b>	! The connector of the MEDIBUS cable was unplugged during operation.	Plug the connector in again and secure it against disconnection with the two screws.
	MEDIBUS cable defective.	Use a new MEDIBUS cable.
	Interface defective.	Call DraegerService.
<b>Mixer inop</b>	!!! Mixer malfunction. FiO <sub>2</sub> can deviate considerably.	<b>Immediately ventilate with separate manual ventilation device!</b> Call DraegerService.
<b>Multi-function board inop</b>	! Multifunction card operating nurse call or remote control pad is faulty.	Acknowledge message with »Alarm Reset« key. Call DraegerService at your earliest convenience.  <b>NOTE:</b> The original ventilator functions of Evita 4 are not affected, the correct function of nurse call or remote control pad, however, are not warranted: Remove nurse call or remote control pad, respectively
<b>Multi-function board inop</b>	!! Multifunction card operating nurse call or remote control pad is faulty.	Acknowledge message with »Alarm Reset« key. Call DraegerService at your earliest convenience.  <b>NOTE:</b> The original ventilator functions of Evita 4 are not affected, the correct function of nurse call or remote control pad, however, are not warranted: Remove nurse call or remote control pad, respectively

Message		Cause	Remedy
<b>MV high</b>	!!!	The minute volume has exceeded the upper alarm limit.	Check patient condition, check pattern of ventilation, correct alarm limit if necessary
		Flow sensor not calibrated or faulty.	Calibrate flow sensor, page 112, and replace if necessary.
		Water in flow sensor.	Drain water trap in hose system.
		Machine malfunction.	Call DraegerService.
<b>MV low</b>	!!!	The minute volume has fallen below the lower alarm limit.	Check patient condition, check pattern of ventilation, correct alarm limit if necessary
		Stenosis.	Check patient condition. Check tube.
		Leak in breathing system.	Establish leakproof breathing system.
		Flow sensor not calibrated or faulty.	Calibrate flow sensor, page 112, replace if necessary.
		Machine malfunction.	Call DraegerService.
<b>Nebulization interrupted</b>	!!	Only in pediatric mode. Nebulization is only possible in pressure-controlled ventilation or with AutoFlow.	Select another breathing mode. Or activate AutoFlow. Restart Nebulization. Acknowledge the alarm with »Alarm Reset«.
		Flow sensor not ready for measurement. (Only in pediatric mode, only for ventilation with AutoFlow.)	Switch on flowmonitoring or calibrate sensor. Restart Nebulization. Acknowledge the alarm with »Alarm Reset«.
<b>Nebulizer on</b>	!	The nebulizer is switched on, page 104.	Switch off the nebulizer if necessary, page 104.
<b>O2 measurement inop.</b>	!!!	O2 sensor provides invalid measured values.	Calibrate O2 sensor, page 111, replace if necessary.
		O2 measurement malfunction.	Call DraegerService.
<b>O2 monitoring off</b>	!	O2 monitoring switched off.	Switch on O2 monitoring again, as described on page 109, or immediately ensure an adequate monitor function.
<b>O2 supply low</b>	!!!	O2 supply pressure too low.	Make sure pressure is greater than 3 bar (43.5 psi).
<b>O2 supply low</b>	!	O2 supply pressure too low. O2 supply pressure is not required when FiO2 = 21 Vol. %.	Make sure pressure is greater than 3 bar (43.5 psi).

Message	Cause	Remedy
<b>O2 pressure high</b>	!! O2 supply pressure too high.	Make sure pressure is less than 6 bar.
<b>O2 pressure high</b>	! O2 supply pressure too high. O2 supply pressure is not required when FiO2 = 21 Vol. %.	Make sure pressure is less than 6 bar.
<b>PEEP high</b>	!!! Expiratory system obstructed.	Check hose system and expiration valve.
	Expiratory resistance is increasing.	Check bacterial filter. Replace if necessary.
	Machine faulty.	Call DraegerService.
<b>PEEP valve inop</b>	!!! Internal PEEP valve faulty.	Call DraegerService.
<b>Pressure limited</b>	! Pmax pressure limit is active.	
<b>Pressure meas. inop</b>	!!! Fluid in expiration valve.	Replace expiration valve, then clean and dry, page 145.
	Pressure measurement malfunction.	Call DraegerService.
<b>Psupp. &gt; 1.5 s</b>	! Only appears in pediatric mode. The Pressure Support cycle has been switched off 3 times due to time limitation.	Test ventilation system for leaks.
<b>Psupp. &gt; 4 s</b>	!!! Only appears in adult mode. The Pressure Support cycle has been switched off 3 times due to time limitation.	Test ventilation system for leaks.
<b>Standby activated</b>	!!! Evita 4 has been switched to standby.	Confirm standby with »Alarm Reset« key.
<b>Temperature high</b>	!!! Breathing gas temperature higher than 40 °C.	Switch off humidifier.
<b>Temperature meas. inop</b>	!!! Temperature sensor faulty.	Fit new temperature sensor.
<b>Temperature sensor?</b>	!!! Temperature sensor probe has been disconnected during operation.	Reconnect probe.
	Sensor cable broken.	Fit new temperature sensor.
<b>Tidal volume high</b>	!!! The upper alarm limit of the applied inspiratory tidal volume has been exceeded during three consecutive ventilation strokes.	Check patient condition, check pattern of ventilation, correct alarm limit if necessary.
	Leak or disconnection.	Check that hose system connections are leakproof.

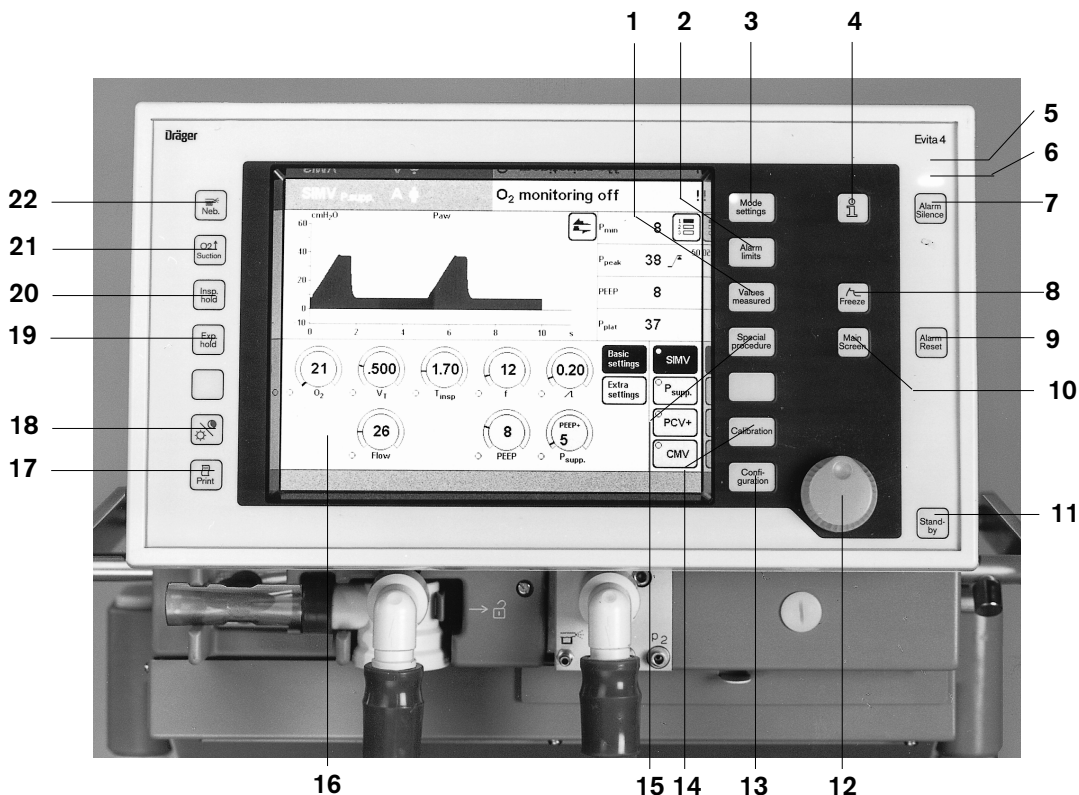
Message		Cause	Remedy
<b>Tidal volume high</b>	!	The inspiratory tidal volume VT has exceeded the upper alarm limit.	Check patient condition, check pattern of ventilation, correct alarm limit if necessary.
		Leak or disconnection.	Check that hose system connections are leakproof.
<b>Volume not constant</b>	!!	Due to pressure limit or time limit, the set tidal volume VT has not been applied.	<p>Prolong inspiratory time »T<sub>insp</sub>«  Increase inspiratory flow »Flow«.  Increase pressure limit »P<sub>max</sub>«.</p> <p>Press the »<b>Alarm Reset</b>« key to suppress the visual and acoustic alarm until the cause of the alarm is remedied.</p>






## What's What

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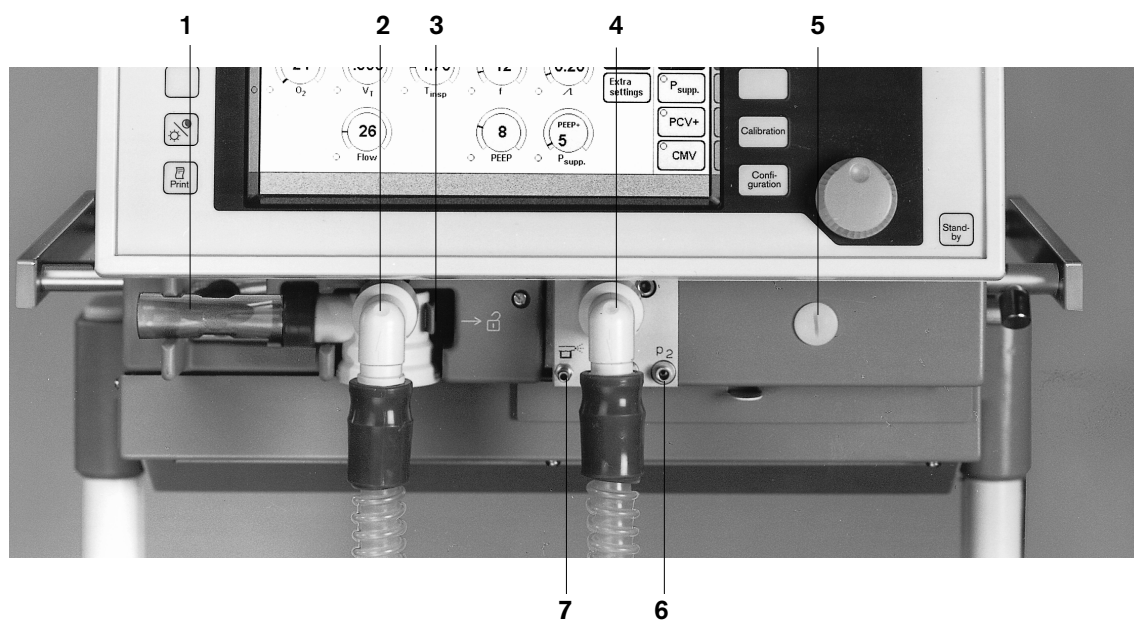
## Control Panel



- 1 Key for displaying »Measured values« screen page.
- 2 Key for displaying »Alarm limits« screen page.  
For displaying measured values and alarm limits, as well as for setting alarm limits.
- 3 Key for displaying »Mode settings« screen page.  
For setting ventilation modes and ventilation parameters.
- 4 »« key for displaying help information for settings.
- 5 Red signal light for WARNING-level alarms.
- 6 Yellow signal light for CAUTION- and advisory level alarms.
- 7 »Alarm Silence« key for silencing audible alarm for 2 minutes.
- 8 » Freeze« key for "freezing" waveforms.
- 9 »Alarm Reset« key for acknowledging alarm messages.
- 10 »Main Screen« key for selecting standard screen page.
- 11 »Stand by« key for switching between operating mode and standby mode.
- 12 Central rotary dial knob for selecting and confirming settings.
- 13 Key for displaying »Configuration« screen page.
- 14 Key for displaying »Calibration« screen page.
- 15 Key for displaying »Special procedures« screen page. For measuring PEEP<sub>i</sub> and Occlusion Pressure.
- 16 Touch sensitive screen for displaying application specific screen pages.
- 17 » Print« key for manual printer logging.
- 18 »« key for switching screen backlighting on/off.
- 19 »Exp. hold« key for manually extending (holding) expiration.
- 20 »Insp. hold« key for manual inspiration.
- 21 »O<sub>2</sub> ↑ Suction« key for oxygenation during bronchial suction.
- 22 » Neb.« key for switching on nebulizer.

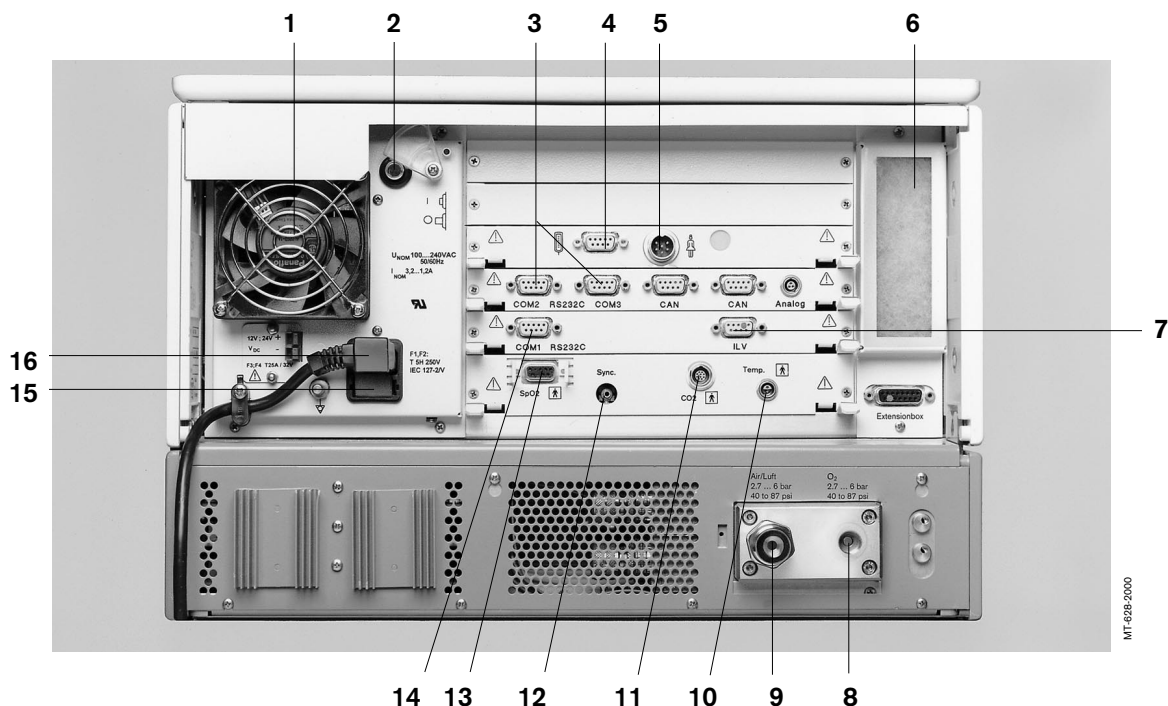







## Front Connections



- 1 Flow sensor
- 2 Expiratory valve with expiratory connector
- 3 Latch for expiratory valve
- 4 Inspiratory port
- 5 Locking screw for protective cover  
(behind it: O<sub>2</sub> sensor and ambient air filter)
- 6 Connections for optional pressure measurement  
(not yet used)
- 7 Gas supply nipple for nebulizer

## Back Panel

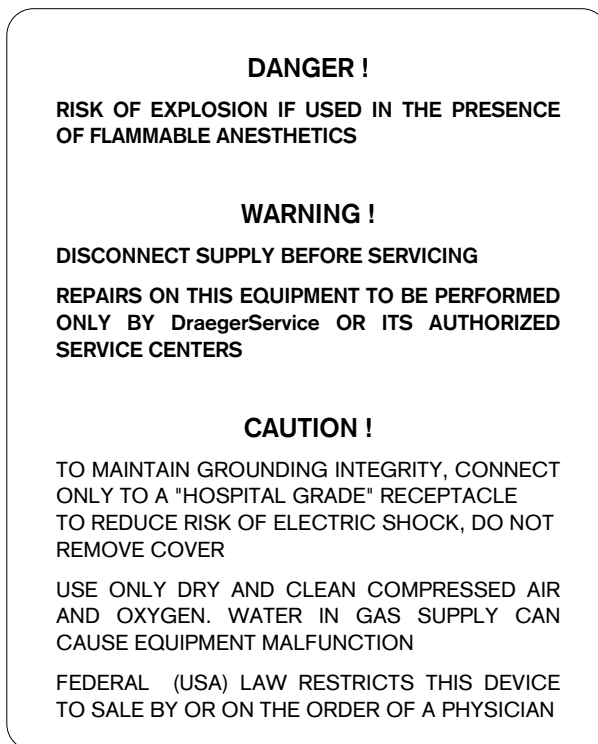


- |  |   |
|--|---|
| 1 Cooling fan  | 13 Connector »SpO <sub>2</sub>  « for SpO <sub>2</sub> measurement |
| 2 Power switch with protective cover   | 14 Connector »COM1 RS232C« for RS 232 interface, e.g. printer   |
| 3 Connectors »COM2«, »COM3« for RS 232 and analog interfaces (available option)  | 15 Fuses  |
| 4 Connection for »  « remote control pad (available option) | 16 Power cord connector   |
| 5 Connection for »  « nurse call (available option)         |   |
| 6 Cooling air filter   |   |
| 7 ILV connector  |   |
| 8 DISS connection for supply of medical grade oxygen   |   |
| 9 DISS connection for supply of medical grade air  |   |
| 10 Temperature sensor socket »Temp  «                       |   |
| 11 CO <sub>2</sub> sensor socket »CO <sub>2</sub>  «        |   |
| 12 Connector for C-lock-ECG synchronization for optional SpO <sub>2</sub> measurement  |   |

## Labels

### Main CAUTION/WARNING label

This label can be found on the left side of the ventilator.



### Air Intake CAUTION label

This label can be found on the right front of the ventilator.



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Technical Data

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## Environmental Conditions

### During operation

Temperature	10 to 40 °C (50 to 104 °F)
Atmospheric pressure	700 to 1060 hPa (525 to 795 mmHg)
Rel. humidity	0 to 90 %

### During storage

Temperature	-20 to 60 °C (-4 to 140 °F)
Atmospheric pressure	500 to 1060 hPa (375 to 795 mmHg)
Rel. humidity	0 to 100 %

## Settings

Ventilator rate f	0.5 to 100 bpm
Inspiratory time T <sub>insp</sub>	0.1 to 10 s
Tidal volume VT	
Pediatric range	0.02 to 0.3 L, BTPS*
Accuracy	greater of ±10 % of set value or ±10 mL,
Adult range	0.1 to 2.0 L, BTPS*
Accuracy	greater of ±10 % of set value, or ±25 mL
Inspiratory Flow	
Pediatric range	6 to 30 L/min
Adult range	6 to 120 L/min
Inspiratory pressure P <sub>insp</sub>	0 to 80 cmH <sub>2</sub> O
Inspiratory pressure limit P <sub>max</sub>	0 to 100 cmH <sub>2</sub> O
O <sub>2</sub> concentration	21 to 100 Vol. %
Accuracy	greater of ±5 % of set value or ±2 Vol. %
Positive end-expiratory pressure PEEP or intermittent PEEP	0 to 35 cmH <sub>2</sub> O
Trigger sensitivity	0.3 to 15 L/min
Pressure support P <sub>Supp.</sub>	0 to 80 cmH <sub>2</sub> O
Rise time for pressure support	0 to 2 s
Independent Lung Ventilation ILV	
Master	with trigger / without trigger
Slave	synchr. / asynchr. / inverse I : E

\* BTPS = Body Temperature, Pressure. Saturated.  
Measured values relating to the conditions in the patient lung,  
body temperature 37 °C, water vapor saturated gas, ambient pressure.

**Performance Data**

Control principle	time-cycled, volume-constant, pressure-controlled
Intermittent PEEP rate	2 cycles every 3 minutes
Nebulization of aerosols	for 30 minutes
Bronchial suction	
Disconnection detection	automatic
Reconnection detection	automatic
Preoxygenation	max. 3 minutes
Active suction phase	max. 2 minutes
Postoxygenation	2 minutes
Valve response time T <sub>0...90</sub>	≤ 5 ms
Demand flow system for spontaneous breathing and pressure support	adaptive CPAP system with high initial flow
max. flow rate	2 L/s in 8 ms
max. inspiratory flow	180 L/min
Ventilator compliance (with humidifier Fisher Paykel MR 730 and reusable silicone adult patient circuit)	≤ 2 mL/cmH <sub>2</sub> O
Insp. Resistance	≤ 2.3 cmH <sub>2</sub> O/L/s
Exp. Resistance	≤ 3.8 cmH <sub>2</sub> O/L/s
Dead Space Volume incl. CO <sub>2</sub> -cuvette	≤ 16 mL
Dead Space Volume CO <sub>2</sub> -cuvette only	approx. 4 mL
Equipment compliance (with humidifier Fisher & Paykel MR 730 and reusable silicone pediatric patient circuit)	≤ 1 mL/cmH <sub>2</sub> O
Insp. Resistance	≤ 4.1 cmH <sub>2</sub> O/L/s
Exp. Resistance	≤ 4.1 cmH <sub>2</sub> O/L/s
Dead Space Volume incl. CO <sub>2</sub> -cuvette	≤ 6 mL
Dead Space Volume CO <sub>2</sub> -cuvette only	approx. 1.5 mL
Additional functions	
Inspiratory relief valve	opens if gas supply fails (pressure < 1.2 bar, 17.4 psi), enables spontaneous breathing with ambient air.
Safety relief valve	opens the breathing system at 100 cmH <sub>2</sub> O.

**Measured Value Displays**

Airway pressure measurement	
Max. airway pressure	P <sub>peak</sub>
Plateau pressure	P <sub>plat</sub>
Pos. end-exp. pressure	PEEP
Mean airway pressure	P <sub>mean</sub>
Min. airway pressure	P <sub>min</sub>
Range	0 to 99 cmH <sub>2</sub> O
Resolution	1 cmH <sub>2</sub> O
Accuracy	±2 cmH <sub>2</sub> O

## Technical Data

### Measured Value Displays

#### O<sub>2</sub> measurement in main flow (inspiratory side)

##### Inspiratory O<sub>2</sub> concentration FiO<sub>2</sub>

Range	15 to 100 Vol. %
Resolution	1 Vol. %
Accuracy	±3 Vol. %

#### Flow measurement

##### Minute Volume MV

##### Spontaneously breathed minute volume MV<sub>spon</sub>

Range	0 to 99 L/min, BTPS*
Resolution	0.1 L/min
Accuracy	±8 % of measured value
T 0...90	approx. 35 s

##### Tidal volume V<sub>Te</sub>

##### Spontaneously breathed tidal volume VT<sub>spon</sub>

Range	0 to 3999 mL, BTPS*
Resolution	1 mL
Accuracy	±8 % of measured value

##### Tidal volume V<sub>TP.Supp.</sub>

##### Spontaneously breathed tidal volume VT<sub>spon</sub>

Range	0 to 3999 mL, BTPS*
Resolution	1 mL
Accuracy	±8 % of measured value

#### Frequency measurement

##### Breathing frequency f<sub>tot</sub>

##### Spontaneous breathing frequency f<sub>spon</sub>

Range	0 to 150 /min
Resolution	1 /min
Accuracy	±1 /min
T 0...90	approximately 35 s

#### Breathing gas temperature measurement

Range	18 to 51 °C
Resolution	1 °C
Accuracy	±1 °C

#### CO<sub>2</sub> measurement (mainstream)

##### End-expiratory CO<sub>2</sub> concentration etCO<sub>2</sub>

Range	0 to 100 mmHg or 0 to 13.3 Vol. % or 0 to 13.3 kPa
Resolution	1 mmHg or 0.1 Vol. % or 0.1 kPa

\* BTPS = Body Temperature, Pressure. Saturated.

Measured values relating to the conditions in the patient lung,  
body temperature 37 °C, water vapor saturated gas, ambient pressure.



Accuracy	
for 0 to 40 mmHg	±2 mmHg
for 40 to 100 mmHg	±5 % of measured value
T 10...90	≤ 25 ms
Warm-up time	max. 3 minutes
CO <sub>2</sub> production $\dot{V}$ CO <sub>2</sub>	
Range	0 to 999 mL/min, STPD <sup>1)</sup>
Resolution	1 mL/min
Accuracy	±9 % of measured value
T 10...90	12 minutes
Serial dead space V <sub>ds</sub>	
Range	0 to 999 mL, BTPS
Resolution	0.1 mL
Accuracy	greater of ±10 % of measured value or ±10 mL
Dead space ventilation V <sub>ds</sub> /V <sub>T</sub>	
Range	0 to 99 %
Resolution	1 %
Accuracy	±10 % of measured value
Computed value displays	
Compliance C	
Range	0.7 to 200 mL/cmH <sub>2</sub> O
Resolution	
range of 0.7 to 99.9 mL/cmH <sub>2</sub> O	0.1 mL/cmH <sub>2</sub> O
range of 100 to 200 mL/cmH <sub>2</sub> O	1 mL/cmH <sub>2</sub> O
Accuracy	±20 % of measured value <sup>2)</sup>
Resistance R	
Range	3 to 200 cmH <sub>2</sub> O/L/s
Resolution	
range of 3 to 99.9 cmH <sub>2</sub> O/L/s	0.1 cmH <sub>2</sub> O/L/s
range of 100 to 200 cmH <sub>2</sub> O/L/s	1 cmH <sub>2</sub> O/L/s
Accuracy	±20 % of measured value <sup>3)</sup>
Leakage minute volume MV <sub>Leak</sub>	
Range	0 to 99 L/min, BTPS
Resolution	0.1 mL/min or 0.01 for values less than 0.1 L/min
Accuracy	±18 % of measured value
T 10...90	approximately 35 s

1) STPD = Standard, Temperature, Pressure, Dry.  
Measured values in relation to standard physical conditions:  
0 °C, 1013mbar, dry

2) C-values may be considerably falsified as spontaneous breathing increases;  
compliance with the measuring accuracy therefore cannot be guaranteed for spontaneous breathing.

3) R-values may be considerably falsified as spontaneous breathing increases;  
compliance with the measuring accuracy therefore cannot be guaranteed for spontaneous breathing..

Monitoring

Waveform displays

Airway pressure $P_{aw}$ (t)	-10 to 100 cmH <sub>2</sub> O
Flow $\dot{V}$ (t)	-150 to 180 L/min
Volume V (t)	0 to 2000 mL
Exp. CO <sub>2</sub> concentration FCO <sub>2</sub>	0 to 100 mmHg or 0 to 13 kPa or 0 to 13 Vol. %
Rapid Shallow Breathing index (RSB)	
Range	0 to 9999 1/(min x L)
Resolution	1/(min x L)
Accuracy	see measurement of VT and f
Negative Inspiratory Force (NIF)	
Range	-45 to 0 cmH <sub>2</sub> O
Resolution	1 cmH <sub>2</sub> O
Accuracy	±2 cmH <sub>2</sub> O

**Monitoring**

Expiratory minute volume MV

Alarm at upper limit	if MV exceeds the upper alarm limit.
Setting range	41 to 0.1 L/min, in 0.1 L/min increments
Alarm at lower limit	if MV falls below the lower alarm limit.
Setting range	0.01 to 40 L/min, in 0.1 L/min increments

Airway pressure  $P_{aw}$

Alarm at upper limit	if the "P <sub>aw</sub> high" value is exceeded.
Setting range	10 to 100 cmH <sub>2</sub> O
Alarm at lower limit	if the value "PEEP +5 cmH <sub>2</sub> O" (linked to set value of PEEP) is not exceeded for at least 96 ms in 2 successive ventilator breaths.

Insp. O<sub>2</sub> concentration FiO<sub>2</sub>

Alarm at upper limit	if upper alarm limit was exceeded for at least 20 seconds.
Alarm at lower limit	if lower alarm limit was exceeded for at least 20 seconds.
Range	both alarm limits are automatically linked to the set value: for settings below 60 Vol.: threshold ±4 Vol. % 60 Vol. % and above: ±6 Vol. %

Insp. breathing gas temperature



Alarm at upper limit	when temperature reaches 40 °C. (Evita 4 can also be used without temperature sensor if the sensor is not connected when switching the ventilator on).
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Tachypnea monitoring

Alarm	during spontaneous breathing, if a preset spontaneous breathing rate has been exceeded.
Adjustment range	5 to 120/min

Volume monitoring	
Alarm at lower limit	if the set tidal volume VT has not been supplied (alarm limit linked to set value of VT).
Alarm at upper limit	if the applied tidal volume exceeds the value of the alarm limit, inspiration is interrupted and the expiratory valve is opened.
Adjustment range	21 to 4000 mL
Apnea alarm time	
Alarm	if no breathing activity is detected
Adjustment range	5 to 60 s, adjustable in 1 second increments.

## Operating Data

Line power connection	100 V to 240 V
50/60 Hz	
Current	
at 230 V	max. 1.3 A
at 100 V	max. 3.2 A
Power consumption	approximately 125 W (typ.)
Ventilator fuses	
Range 100 V to 240 V	F 5 H 250 V IEC 127-2 (2x)
Protection class	
Ventilator	Class I
CO <sub>2</sub> sensor connected	Type BF 
Temperature sensor connected	Type BF 
Gas supply	
O <sub>2</sub> gauge pressure	43.5 psi (3 bar) –10 % to 79.75 psi (5.5 bar) at 60 L/min (peak flow 200 L/min)
O <sub>2</sub> connection thread	DISS, male (oxygen)
Air gauge pressure	43.5 psi (3 bar) –10 % to 79.75 psi (5.5 bar) at 60 L/min (peak flow 200 L/min)
Air connection thread	DISS, male (air) The gases must be dry and free from oil and dust (medical grade).
Gas consumption of control system	Medical grade Air or O <sub>2</sub> approx. 3.5 L/min
Output for pneumatic nebulizer	Medical grade Air or O <sub>2</sub> max. 29 psi (2 bar) max. 10 L/min
Automatic gas crossover	if one gas fails (supply pressure < 22 psi), the ventilator will switch to the other gas supply.
Sound pressure level (for free-field measurement over a reflecting surface)	max. 47 dB (A)

Dimensions (W x H x D)

Main ventilator	530 x 290 x 450 mm (20.9" x 11.4" x 17.7")
Ventilator with mobile stand	550 x 1336 x 559 mm (21.7" x 52.6" x 22.0")

Weight

Main ventilator	approx. 30 kg (60 lbs)
Ventilator with mobile stand incl. cabinet 8H	approx. 72 kg (152 lbs)

## Ventilator Interfaces

Digital input/output

COM 1

Output and input via an RS 232 C interface

LUST protocol

Baud rates: 1200, 2400, 4800, 9600, 19200 Baud

Data bits: 7

Parity: even

Stop bits: 1

MEDIBUS protocol

Baud rates: 1200, 2400, 4800, 9600, 19200 Baud

Data bits: 8

Parity: even, odd, none

Stop bits: 1 or 2

(For the transmission of fast data, e.g. for the flow curve, 19200 Baud are required)

Printer protocol Hp DeskJet, 500 series

Baud rates: 1200, 2400, 9600, 19200 Baud

Data bits: 8

Parity: none

Stop bits: 1

Cable length

up to 15 m (45 foot)

Load impedance

3000 to 7000  $\Omega$

Signal voltage

(for 3000 to 7000  $\Omega$  impedance)

Low

between 3 and 15 V

High

between -3 and -15 V

Isolation protection

COM 1 terminal is galvanically isolated from the ventilator electronics.

Test voltage for galvanic isolation is 1500 V.

Pin description

Pin2	RxD
Pin 3	TxD
Pin 5	GND
Connector housing	Ventilator housing

Digital output

Output for independent lung ventilation (ILV)

Digital input/output (optional)

for output and input via two RS 232 C interfaces

Digital input/output (optional)

for output and input via a CAN interface

Analog output (optional)

for output of analog data

## Standards and Classifications

### Performance Standards

The Evita 4 ventilator is designed to comply with ISO 5369 and EN 794 "Lung Ventilators" as well as ASTM F 1100 "Standard Specification for Ventilators for Use in Critical Care".

**Electromagnetic compatibility EMC** tested pursuant EN 60601-1-2  
(pursuant directive 89/336/EEC)

**Classification** IIb  
(according to EC directive 93/42, Appendix IX)

**UMDNS Code** 17-429  
(Universal Medical Device Nomenclature System)

### Materials Used

Part	Appearance	Material
Ventilation circuit (reusable)	milky, transparent	silicone rubber
Water traps	yellow, transparent	polysulphone
Y-piece with connector for temperature measurement	yellow, transparent	polysulphone
	milky, transparent	silicone rubber
Expiratory valve housing, closure	white	polyamide
Diaphragm	whitish and gray	silicone rubber and aluminum
CO <sub>2</sub> cuvette	yellow, transparent	polysulphone with glass windows
Temperature sensor / cable	milky / green or blue	silicone rubber
CO <sub>2</sub> sensor / cable	gray / gray	polyurethane

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## Theory of Operation

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## Ventilation Modes

### Volume Controlled Ventilation with PLV and AutoFlow®

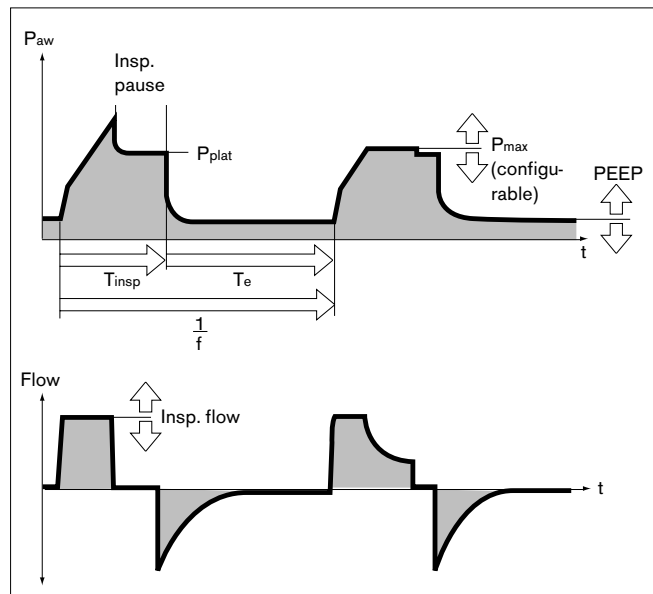
AutoFlow is a new supplement optimizing inspiratory flow during mandatory ventilator breaths in the volume controlled ventilation modes CMV, SIMV and MMV. To explain the improvement achieved by this feature, the conventional functions are described first:

#### Classic volume constant mandatory ventilator breath

In mandatory ventilation modes without AutoFlow, the parameter »Insp.Flow« restricts inspiratory flow. If the inspiratory flow is high enough and set tidal volume  $V_T$  is reached before inspiratory time  $T_{\text{insp}}$  is over, the inspiratory valve will close and the supply of breathing gas will stop. The expiratory valve remains closed until the end of inspiratory time  $T_{\text{insp}}$ . This phase, the inspiratory pause, can be identified in the  $P_{\text{aw}}$  (t) waveform as the plateau with a pressure  $P_{\text{plat}}$ .

This type of mandatory ventilator breath, which, for technical reasons, is found in the same form in almost all intensive care ventilators, has two considerable drawbacks:

- If the lungs are extremely non-homogeneous, the pressure peaks can lead to the overdistension of individual lung areas, and
- unless the pattern of ventilation is regularly adapted to the needs of the spontaneously breathing patient, the limited inspiratory flow and closed inspiratory and expiratory valves during the inspiratory pause can cause the patient to "fight" the ventilator.



#### Manual pressure limit $P_{\text{max}}$

Evita 4 can prevent pressure peaks while maintaining the set tidal volume  $V_T$  by setting a pressure limit  $P_{\text{max}}$ . The tidal volume  $V_T$  remains constant as long as a pressure plateau  $P_{\text{plat}}$  is still detectable in the pressure waveform and the flow curve shows a brief zero flow phase between inspiration and expiration.

Evita 4 performs this function by reducing inspiratory flow upon reaching the set value for  $P_{\text{max}}$ . If the set tidal volume  $V_T$  can no longer be filled with the selected pressure  $P_{\text{max}}$  due to reduced compliance, the alarm "Volume not constant" is automatically generated. Manual pressure limiting can be performed with all ventilators of the Evita family.



**AutoFlow®**

AutoFlow can be activated in the »Extra Settings« menu. AutoFlow takes over the task of setting both »Insp.Flow« and »P<sub>max</sub>«: the screen knobs for these parameters are no longer displayed.

With AutoFlow, the inspiratory flow is automatically adjusted to changes in lung conditions (C, R) and to the demands of the spontaneously breathing patient .

**WARNING !**

**Always set the alarm limit »Paw  $\nearrow$ « in order to generate an alarm in the event of an increase in airway pressure with reduced compliance.**

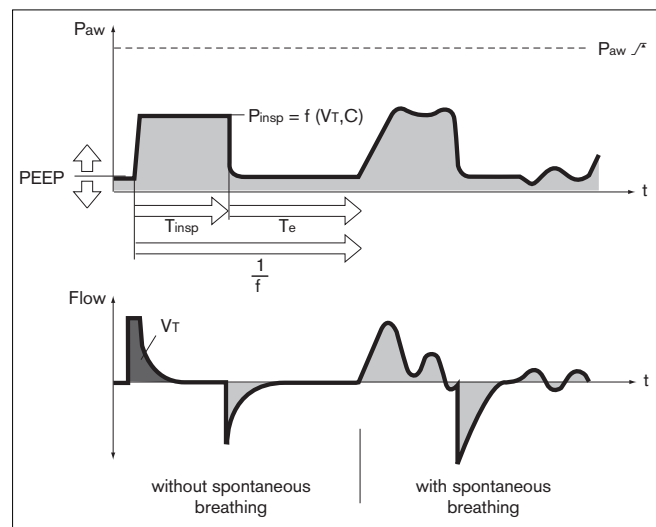
Typically, the selected inspiratory time  $T_{\text{insp}}$  is much longer than the time required to fill the lungs. The minimum inspiratory pressure  $P_{\text{insp}}$  corresponds to the value calculated from the tidal volume  $V_T$  and compliance  $C$  of the lung.

Inspiratory flow is now automatically controlled so that there is no pressure peak caused by ET-tube and airway resistance. The plateau pressure  $P_{\text{plat}}$  is allowed to fluctuate with changes in compliance  $C$ , as is common with all constant volume ventilator breaths. With AutoFlow, these fluctuations occur in increments with a maximum of 3 cmH<sub>2</sub>O between ventilator breaths.

If tidal volume  $V_T$  is reached (inspiratory flow = 0) before inspiratory time  $T_{\text{insp}}$  has fully elapsed, the control system for the inspiratory and expiratory valves ensures that the patient can breathe in and out during the remaining inspiratory time, even during the constant pressure plateau  $P_{\text{plat}}$ .

If the patient breathes in or out during mandatory inspiration, the plateau pressure  $P_{\text{plat}}$  is not changed for the duration of this ventilator breath: only inspiratory and expiratory flow are adapted to the patient's demand. The applied tidal volume  $V_T$  may differ from the set tidal volume  $V_T$  in individual ventilator breaths, but as an average over time a constant tidal volume  $V_T$  is supplied.

Overshoot in tidal volume  $V_T$  can be limited by the alarm limit »VTi  $\nearrow$ «. If the set alarm limit is exceeded once, Evita 4 generates an advisory (!) message; if the alarm limit is exceeded three times, Evita 4 generates a warning (!!!). Tidal volume is actively limited to the value of the alarm limit »VTi  $\nearrow$ « by switching to PEEP level (expiration) when necessary.



**WARNING !**

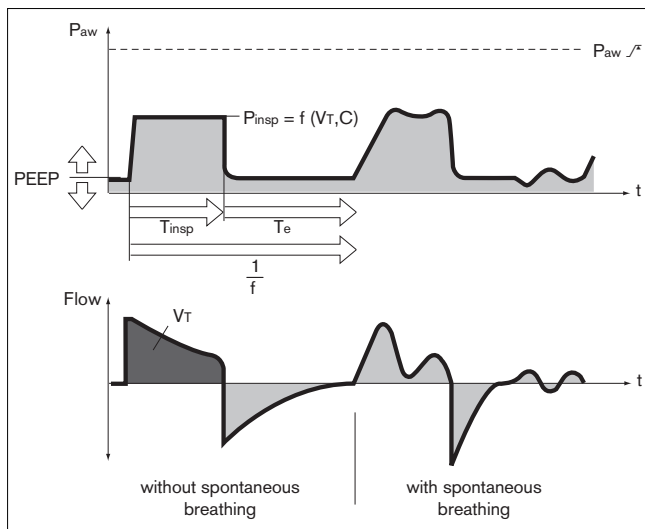
Always set alarm limits  $\Delta P_{aw}$  and  $\Delta P_{aw}$  to avoid over- or under-ventilating a patient with a rapidly changing compliance.

An inspiratory time  $T_{insp}$  set to a value shorter than the time required to fill the lungs can be recognized in the flow waveform: the flow at the end of inspiration has not dropped to zero. Then, it must be decided whether the current patient condition permits extending inspiratory time in order to reduce peak pressure even further.

The effect described can also develop in the course of ventilation, e.g. due to a buildup of secretions. In this situation, pressure is limited by the alarm limit  $\Delta P_{aw}$ . The pressure rise is held to 5 cmH<sub>2</sub>O below the alarm limit  $\Delta P_{aw}$ . The "Volume not constant" alarm will only become active when the set tidal volume  $V_T$  is no longer fully applied.

The start of a mandatory inspiration can be synchronized with a patient's own efforts using the adjustable flow trigger. Only while in CMV mode can the flow trigger be completely switched off (CMV Assist  $\rightarrow$  CMV).

The steepness of the pressure rise from PEEP level to the inspiratory level can be even more closely adapted to the needs of the patient by adjusting pressure rise time  $\Delta P_{aw}$ .

**Startup procedure with AutoFlow**

When AutoFlow is switched on, Evita 4 applies a volume controlled ventilator breath with minimum inspiratory flow and subsequent inspiratory pause.

The plateau pressure  $P_{plat}$  calculated for this ventilator breath serves as the startup value for inspiratory pressure under AutoFlow.

## Sigh

"Sigh" operates in the form of an intermittent PEEP in CMV, CMV Assist and ILV.

The purpose of expiratory sigh during ventilation is to open collapsed areas of the lung, or to keep open "slow" areas of the lung.

Since atelectatic alveoli have a longer time constant – also caused by obstructed bronchioli – increased airway pressure maintained over a longer period is required to open them.

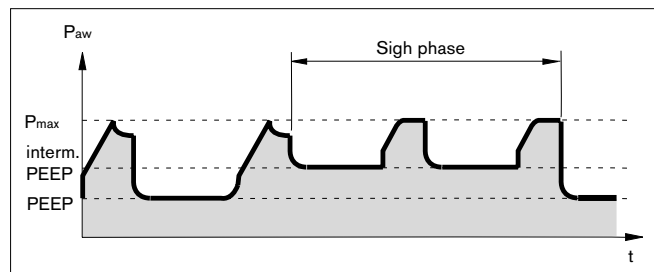
Commonly, a sigh breath is achieved by simply increasing the pressure level of a ventilator breath; however, due to the short time available, the filling of the »slow« alveoli is only marginally improved.

In the Evita 4, the sigh operates during expiration with an intermittent PEEP for 2 breaths every 3 minutes.

Mean airway pressure is higher, and a longer filling time can be expected.

In order to avoid lung overinflation, pressure peaks during the sigh phase can be limited using pressure limit  $P_{\max}$  without impairing the sigh function.

During the sigh phase, the "Volume not constant" alarm is disabled.



## SIMV

### Synchronized Intermittent Mandatory Ventilation

Combination of ventilator breaths and spontaneous breathing.

SIMV enables the patient to breathe spontaneously during predefined, regular ventilation pause intervals, while mandatory mechanical breaths provide a minimum ventilation during the remaining cycle time.

Minimum ventilation is controlled by setting two parameters: tidal volume (VT) and ventilator rate (f). It is then the result of the product of  $VT \times f$ .

The ventilation pattern results from the set values of VT, Insp. Flow, breath rate f and inspiratory time  $T_{\text{insp}}$ .

The flow trigger of the ventilator ensures that a ventilator breath is triggered in synchrony with a patient's spontaneous inspiratory effort within a "trigger window". This prevents mandatory ventilator breaths from being applied during spontaneous expiration.

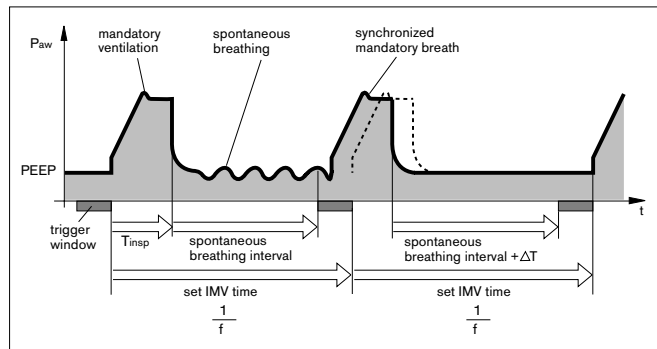
The duration of the trigger window is 5 seconds in adult patient mode and 1.5 seconds in pediatric mode, respectively. If the expiratory time is less than 5 seconds (or 1.5 seconds in pediatric mode), the trigger window covers the entire expiratory time.

Synchronization of mandatory ventilator breaths by itself effectively reduces SIMV time, which would result in an undesirable increase in the effective IMV rate. Evita 4 therefore extends the subsequent time allowed for spontaneous breathing by the lost time difference  $\Delta T$  – thus preventing an increase in the SIMV rate. The mandatory breathing rate f, together with tidal volume VT responsible for minimum ventilation, is kept constant.

If the patient has inspired a significant volume at the beginning of the trigger window, the ventilator reduces its subsequent mandatory breath by shortening the time for the inspiratory flow phase and overall inspiratory time. Tidal volume VT remains constant, and overinflation of the lungs is avoided.

During the spontaneous breathing phases, the patient can be assisted with pressure using Pressure Support.

As part of progressive weaning, the breath rate f is further reduced on the ventilator, thus extending the periods of spontaneous breathing until the required minute volume is eventually supplied entirely by spontaneous breathing.



## Pressure Support

Pressure support for insufficient spontaneous breathing.

The ventilator function for assisting insufficient spontaneous breathing is similar to that of an anesthetist manually assisting and monitoring a patient's spontaneous breathing by feeling the breathing bag.

The ventilator takes over part of inspiration, with the patient maintaining control of spontaneous breathing.

The CPAP system supplies the spontaneously breathing patient with breathing gas even during weak inspiratory efforts.

Pressure support is started:

- when the spontaneous inspiratory flow reaches the set value of the flow trigger, or, at the latest
- when the spontaneously inspired volume exceeds 25 mL (12 mL in pediatric patient mode).

The ventilator then produces an increase in pressure up to the preselected support pressure  $P_{\text{Supp.}}$ , which is adjustable to the breathing requirements of a patient.

The pressure rise time is adjustable from 64 milliseconds to 2 seconds.

With a rapid pressure rise  $\nearrow$

Evita 4 supports the insufficient spontaneous breathing of the patient with a high peak flow.

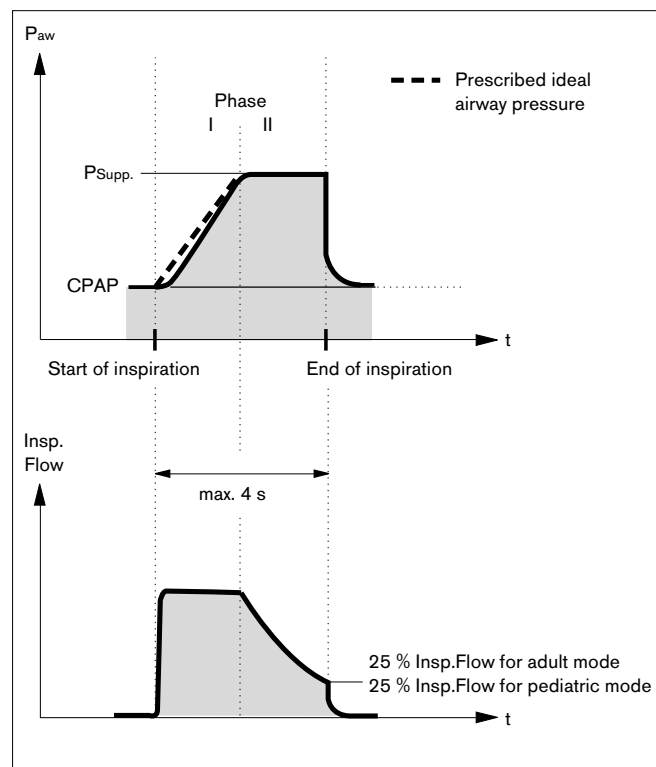
With a slow pressure rise  $\nearrow$

Evita 4 begins gently with regular inspiratory flow. The patient has to contribute more to the breathing effort, and breathing muscles are trained.

With the patient adjusted pressure rise  $\nearrow$  and pressure support level, the patient's own breathing activity determines the required inspiratory flow, which can rise to 2 L/s in just 8 ms.

Pressure support is terminated:

- when inspiratory flow returns to zero during phase I (see diagram on right), i.e. when the patient exhales or fights the ventilator, or
- when inspiratory flow in phase II falls below a certain ratio when compared to the peak inspiratory flow previously supplied:  
for adult ventilation: 25% of inspiratory flow  
for pediatric ventilation: 25% of inspiratory flow, or
- at the latest after 4 seconds (1.5 seconds during pediatric ventilation) if the two other criteria have not triggered termination of the breath  
If this 4-second criterium is activated three times in succession, Evita 4 will generate an alarm and will alert to the possibility of a leak in the patient circuit.



## PCV<sup>+</sup> (BIPAP)

(Pressure Controlled Ventilation Plus)

The PCV<sup>+</sup> (BIPAP) ventilation mode is a pressure/time-cycled ventilation mode in which the patient can always breathe spontaneously. PCV<sup>+</sup> is therefore often described as a time-cycled alternation between two CPAP levels.\*

The time-cycled change of pressure provides controlled ventilation, which is a form of pressure controlled ventilation PCV. However, the continuously available opportunity of spontaneous breathing allows the transition from controlled breathing to independent spontaneous breathing to take place smoothly during weaning, without requiring any change in the mode of ventilation. Both the change from expiratory to inspiratory pressure level, as well as the change from inspiratory to expiratory pressure level are patient synchronized for easy adaptation to a patient's spontaneous breathing pattern.

The rate of the pressure level changes is kept constant, even though synchronization occurs via a trigger time window with a fixed time constant.

The duration of the "trigger window" is 5 seconds in adult patient mode and 1.5 seconds in pediatric mode, respectively. If the expiratory time is less than 5 seconds (or 1.5 seconds in pediatric mode), the trigger window covers the entire expiratory time.

At the  $P_{\text{insp}}$  pressure level, the "trigger window" is  $1/4 \times T_{\text{insp}}$  seconds long.

Recent clinical research\*\* has shown this smooth adaptation to the patient's spontaneous breathing to require less sedation, allowing the patient to return to spontaneous breathing more rapidly.

As in all pressure controlled ventilation modes, the patient is not locked into a fixed tidal volume (VT). The tidal volume basically results from the pressure difference between settings for PEEP and  $P_{\text{insp}}$ .

Changes in lung compliance and airways, as well as the patient's active breathing against the ventilator, can lead to changes in tidal volume. This is a desired effect in this ventilation mode.

Knowing that tidal volume, and therefore minute volume, are not constant, the alarm limits for minute volume must be carefully adjusted.

The display of measured expiratory tidal volume  $VT_e$  must be used to set the required difference between the two pressure levels. Any increase in the pressure differential will cause an increased PCV<sup>+</sup> ventilator breath.

\* References (3), (4), (7), (11), (12), see page 200

\*\* Reference (8), see page 200

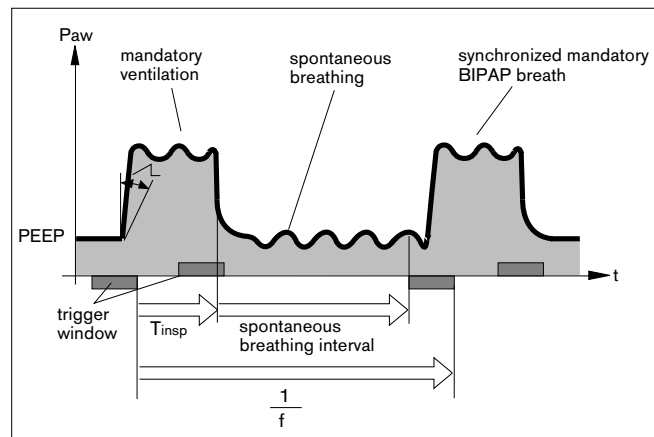
### Using PCV+

As with CMV, the time pattern is set using the basic setting parameters of ventilator rate  $f$  and inspiratory time  $T_{\text{insp}}$ . Evita 4 calculates the resulting inspiratory and expiratory times and displays them in the lower graphics screen field below the waveform display. The lower pressure level is set with the PEEP parameter, while the upper level is set with  $P_{\text{insp}}$ .

When switching modes from SIMV to PCV+, only the  $P_{\text{insp}}$  setting needs to be changed - while maintaining the previous timing pattern.

The steepness of the increase from the lower pressure level to the upper pressure level is controlled by the  $\Delta$  setting. The effective time for the increase in pressure cannot become greater than the set inspiratory time  $T_{\text{insp}}$ .

This precaution ensures that the upper pressure level  $P_{\text{insp}}$  is reached reliably during inspiration. During weaning, the transition from controlled ventilation to fully spontaneous breathing is achieved by gradually reducing inspiratory pressure  $P_{\text{insp}}$  and/or rate  $f$ .



### PCV+Assist (BIPAPAssist)

(Pressure Controlled Ventilation Plus, Assisted)

Pressure controlled, assisted ventilation

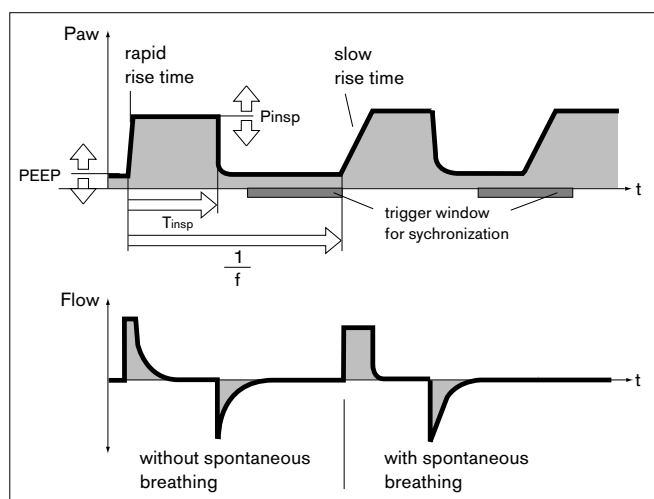
Inspiratory ventilator cycles are equivalent to those of PCV+, however, the switch from  $P_{\text{insp}}$  to PEEP is not synchronized with patient expiration.

The duration of  $P_{\text{insp}}$  is rather determined by  $T_{\text{insp}}$ . Spontaneous breathing is possible anytime during the ventilation.

Each recognized inspiratory effort by the patient will trigger a synchronized inspiratory cycle.

The ventilator will start a non-synchronized inspiratory cycle at the latest after the inspiratory time fixed by »f« and » $T_{\text{insp}}$ « has elapsed.

Used for patients without spontaneous breathing all the way to patients with spontaneous breathing just before extubation.

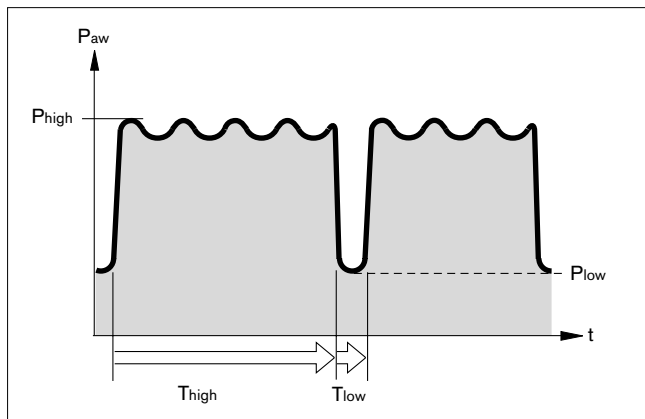


**APRV****Airway Pressure Release Ventilation**

Spontaneous breathing under continuous positive airway pressure with brief pressure release. This ventilation mode is suitable for patients with poor gas exchange. The patient breathes spontaneously at a high pressure level  $P_{high}$  for an adjustable length of time  $T_{high}$ . For very short expiration times  $T_{low}$ , Evita 4 switches to a low pressure level  $P_{low}$ . The normal lung areas are emptied, but the "slow" lung areas only change volume to a lesser extent.\*

The ventilation/perfusion ratio can be improved this way for patients with poor gas exchange.

The steepness of the increase from the lower pressure level to the upper pressure level is controlled by the setting of  $\angle$ . The effective time for the increase in pressure cannot become greater than the time set for  $T_{high}$ .

**MMV****Mandatory Minute Ventilation**

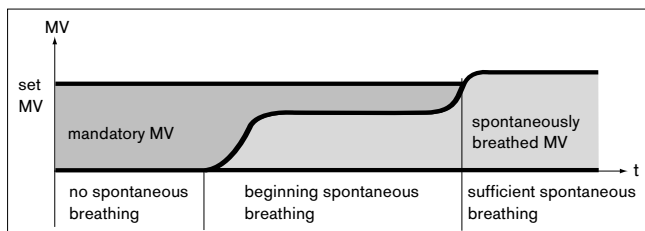
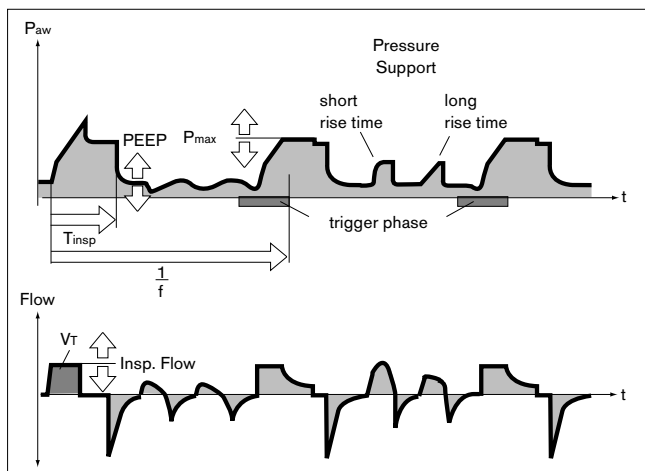
In contrast to SIMV, the MMV ventilation mode provides mandatory breathing only if spontaneous breathing is not yet sufficient and has fallen below a preselected minimum minute ventilation.

This minimum ventilation is controlled by the two set values of tidal volume  $V_T$  and ventilator rate  $f$  as a result of the product  $V_T \times f$ .

Unlike SIMV, mandatory breaths are not applied regularly but only during periods of insufficient ventilation.

The frequency of mandatory breaths is determined by the level of spontaneous breathing: if spontaneous breathing is sufficient, mandatory breaths are not used at all. If spontaneous breathing is not sufficient, intermittent mandatory breaths of the set tidal volume  $V_T$  are applied. With no spontaneous breathing at all, the mandatory breaths are applied at the set rate  $f$ .

Evita 4 continuously balances the difference between spontaneous breathing and the set minimum ventilation. As soon as the balance becomes negative due to insufficient spontaneous breathing, Evita 4 applies a mandatory ventilator breath at the set tidal volume  $V_T$ , so that the balance is again positive.



\* References (6), (7), (8), (9), see page 200



Experience shows that patients breathe very irregularly. Phases of weak breathing alternate with phases of strong breathing. In order to allow for these individual fluctuations, the balancing process also takes into account the amount of minute ventilation that has exceeded the set minimum.

After an apnea, this positive balance is progressively reduced to zero by Evita 4 within a maximum of 7.5 seconds.

Hence, the response time of Evita 4 is automatically adapted to the preceding cycles of spontaneous breathing before activating mandatory ventilation:

If the level of this spontaneous breathing was close to the minimum ventilation, the ventilator responds rapidly within the IMV time. By contrast, if the patient's spontaneous breathing was much higher than the set minimum ventilation, Evita 4 tolerates a longer breathing pause.

In the extreme case of a sudden apnea after a phase of heavy breathing, the response time will be 7.5 seconds plus the trigger time, with a minimum of 1 IMV cycle time.

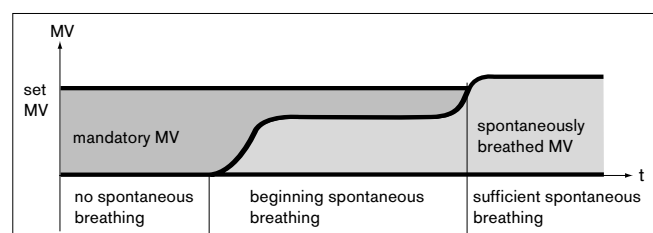
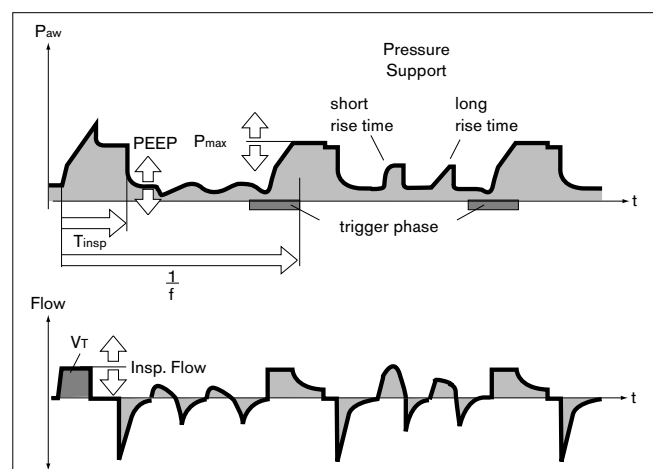
Response times longer than 15 seconds can only occur if minimum ventilation has been set to a corresponding low value with a very low breath rate  $f$ .

In this case, Evita 4 will trigger an apnea alarm that will disappear again after the start of mandatory ventilator breaths. If IMV-time was set to a value longer than the alarm limit  $T_{Apnea}/\tau$  and no spontaneous breathing occurs between the mandatory breaths, an apnea alarm would be triggered regularly.

Example:  $f = 3/\text{min} \cong \text{IMV cycle time } (1/f) = 20 \text{ seconds}$

$$T_{Apnea}/\tau \cong 15 \text{ seconds}$$

This is intended to prevent irregular spontaneous breathing from prematurely triggering a mandatory ventilator breath, while providing an alarm in the case of extended low ventilation levels.



## Flow Measurement

Independent of whether ventilation is pressure or volume controlled, positive pressures are generated both in the patient circuit as well as in the patient's lung.

The volume delivered by the ventilator is distributed to both the patient lung and the circuit used between patient and ventilator. The distribution occurs according to the ratio of lung compliance versus patient circuit compliance.

Resulting expiratory deviations for the measured value of flow and the calculated values of minute ventilation and tidal volume are minimal when ventilating adults. This is due to the relatively large lung compliance compared to the compliance of the patient circuit.

Since only the volume actually entering and leaving the lungs is relevant for the efficiency of ventilation, and since larger deviations would be possible during pediatric ventilation, Evita 4 always compensates for the influence of patient circuit compliance.

### **Compensating for the effect of patient circuit compliance**

During the ventilator check before the start of ventilation, Evita 4 determines the compliance of the patient circuit. It then compensates the effect of this compliance on flow and volume measurement during ventilation.

Dependent on airway pressure, Evita 4 increases ventilatory volume in the same amount that will be remaining in the ventilation circuit.

Besides the influence of patient circuit compliance flow/volume measurement is affected by the physical parameters such as temperature and humidity as well as by leaks in the circuit system. Evita 4 takes these effects into account and corrects set and measured values accordingly.

### **Recalculating for standardized gas conditions**

The volume of a gas depends on the gas conditions, temperature, pressure, and humidity.

For the purposes of lung physiology, reference is made to the conditions inside the lung for values of minute ventilation and tidal volume:

37°C body temperature, pressure inside the lung,  
100% relative humidity.

Measured values for flow and volume under these conditions are characterized as BTPS\*. Medical gases from cylinders or from a central supply are dry (approximately 0% relative humidity) and are delivered at 20°C from the ventilator. Flow and volume measurements under these conditions are characterized as NTPD\*\*. The difference between values measured as NTPD or BTPS is typically around 12 %.

Example: 500 mL tidal volume NTPD become 564 mL BTPS when warmed to 37°C and humidified to 100 % relative humidity.

Evita 4 controls tidal volume in such a way that the set value of tidal volume is applied under BTPS conditions in the lung.

### Automatic Leak Compensation

Evita 4 determines the difference between the flow delivered during inspiration and the flow measured during expiration.

This difference is a measure of the size of any leak and is displayed by Evita 4 as leakage minute volume  $MV_{Leak}$ . During volume controlled ventilation, Evita 4 is able to compensate for the leak.

Example:

Set tidal volume  $V_T = 500$  mL, 10% tube leak.

#### With leak compensation off

Evita 4 delivers 500 mL. The delivered value is displayed as 500 mL. 50 mL escape as leakage during inspiration, 450 mL enter the lung. 450 mL are also expired, of which 45 mL again will escape through the leakage. 405 mL are measured in the expiratory side and are displayed as  $V_{Te}$ .

As a result, an inspiratory minute volume of 5.0 L/min will be delivered at a breath rate of 10 bpm and an expiratory minute volume of 4.05 L/min will be measured. The lung is ventilated with an MV of 4.5 L/min.

**Without leak compensation, the set value of  $V_T$  directly determines the amount of volume Evita 4 is going to deliver.**

#### With leak compensation on

With its automatic leak compensation, Evita 4 will not deliver 500 mL tidal volume, but rather 555 mL based on the measured leak minute volume. 500 mL enter the lung and the inspiratory tidal volume  $V_{Ti}$  is also 500 mL.

This value is displayed as  $V_T$ .

Measured expiratory tidal volume is displayed uncompensated even when compensation is switched on and will therefore show 450 mL.

Expiratory measured minute volume is 4.5 L/min. This value also remains intentionally uncompensated. Otherwise, leak compensation might obscure a low minute volume alarm. Evita 4 is intended to generate an alarm in any case of low minute ventilation.

**With leak compensation, the set value of VT directly determines the amount of volume the patient is going to receive.**

The example has been presented in a simplified fashion: calculation of leak compensation takes into account the pressures in the circuit system. The inspiratory loss of volume is a higher percentage than the expiratory loss since pressure is higher during inspiration. The leakage minute volume  $MV_{Leak}$  is referenced to mean pressure  $P_{mean}$ .

Leakage minute volume  $MV_{Leak}$  also takes into account inspiratory leaks. The sum of minute volume  $MV$  + leakage minute volume  $MV_{Leak}$  therefore exceeds the minute volume that is actually delivered to the patient during inspiration.

Unlimited volume compensation is not appropriate. Evita 4 will compensate volume losses up to 100% of the set tidal volume  $VT$ . Due to technical tolerances small leakage minute volumes may be displayed even for a tight patient circuit.

## Weaning Parameters

P 0.1, RSB, NIF:

A physician judging the ability of a patient to be weaned off the ventilator will consider a number of criteria. Besides diagnostic and laboratory results, ventilatory parameters may be used for estimating the likelihood of successful weaning.

Evita 4 calculates the following weaning indicators:

- Occlusion Pressure P 0.1
- Rapid Shallow Breathing Index RSB
- Negative Inspiratory Force NIF

### Occlusion Pressure

Respiratory drive can be measured at the start of an inspiration by measuring mouth pressure during a short-term occlusion: within a duration of 100 ms the pressure is not influenced by physiological reactions that would try to compensate for the occlusion (e.g. reflexive interruption of breathing or increased respiratory drive). In principle, this pressure is also independent of the muscle strength of the diaphragm. Therefore, the negative mouth pressure P 0.1 after 0.1 seconds is a direct measure of neuromuscular breathing drive\*.

For patients with healthy lungs and regular breathing, P 0.1 will be about 3 to 4 cmH<sub>2</sub>O. A high P 0.1 signals a high respiratory drive which can only be maintained for a limited period of time. P 0.1 values above 6 cmH<sub>2</sub>O, e.g. in a COPD\*\* patient, indicate impending exhaustion (respiratory muscle fatigue).

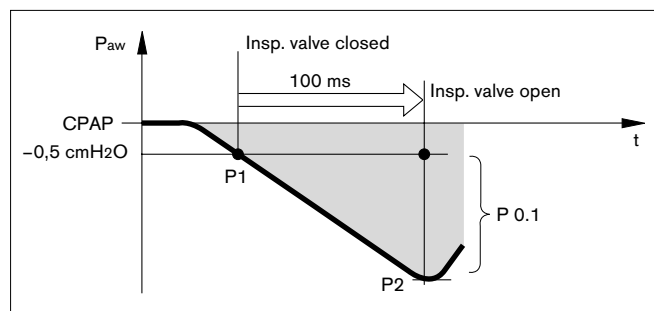
When weaning COPD patients off the ventilator, measurement of P 0.1 can help define the weaning point.

To measure P 0.1, Evita 4 keeps the inspiratory valve closed after an expiration and measures the airway pressure produced by the patient's inspiratory effort during 100 ms (P1).

The 100 ms time interval starts when a negative pressure of -0.5 mbar is measured as a result of the inspiratory effort.

A second pressure reading (P2) is taken after 100 ms. Simultaneously, the inspiratory valve is opened so that the patient can breathe again normally.

Occlusion pressure P 0.1 is defined as the difference between pressure values P2 – P1.



\* Reference (10), see page 200

\*\* COPD = Chronic Obstructive Pulmonary Disease

## Rapid Shallow Breathing Index RSB

The Rapid Shallow Breathing index (RSB)\* is quotient of spontaneous breathing frequency (spontaneous breath per minute) and tidal volume.

$$\text{RSB} \left[ \frac{1}{(\text{min} \times \text{L})} \right] = \frac{f_{\text{spont}} \left[ \frac{1}{\text{min}} \right]}{\text{VT} \left[ \text{L} \right]}$$

The smaller the RSB index for a spontaneously breathing patient, the higher the probability for successful weaning. The predictive power of the RSB index is tied to the fact that patients that can be successfully weaned have a tendency to show lower spontaneous breath rates and higher tidal volumes than patients not ready for weaning. Yang and Tobin were able to show in a 1991 study\* that the RSB index is a good predictor for the success of a weaning attempt. Patients with a RSB index  $< 100 \frac{1}{(\text{min} \times \text{L})}$  were weaned with a probability of 80%.

On the other hand, 95% of patients with a RSB index of  $> 100$  were not ready for weaning.

Evita 4 shows the RSB index in CPAP/P.Supp.

## Negative Inspiratory Force NIF

The Negative Inspiratory Force index (NIF)\*\* measures the maximum inspiratory effort of a patient after a preceding expiration. The patient system is closed during the measurement of NIF. The NIF value is also called Maximum Inspiratory Pressure (MIP).

During a manually extended expiration, the patient generates a negative pressure relative to PEEP. The stronger this negative pressure, the more likely a successful extubation is going to be. Patients reaching a NIF

$< -30 \text{ cmH}_2\text{O}$  can be successfully extubated with a high probability, whereas extubation for patients with a NIF of down to  $-20 \text{ cmH}_2\text{O}$  is very likely to fail.

Evita 4 determines the value of the NIF index during a manually extended expiration. While the »Exp. hold« key is pressed, the patient system is closed after an expiration and Evita measures the maximum inspiratory patient effort. The value of NIF is measured as a pressure relative to PEEP. Releasing the »Exp. hold« key after a maximum of 15 seconds completes the measurement maneuver. The ventilator shows the last NIF value measured and the time of measurement in its table 2 of measured values.

\* Reference (16), see page 200

\*\* Reference (17), (18) see page 200

## Intrinsic PEEP

Measuring intrinsic PEEP is accomplished in two phases.

Evita 4 keeps the inspiratory valve and expiratory valve closed during measuring interval 1, so that it is impossible for gas either to flow into the patient circuit or to escape from it. During this closed phase, pressure is equalized between the lungs and the circuit system.

Evita 4 measures pressure over time.

Measuring interval 1 is terminated:

- when no pressure changes are detected any longer  
– at the earliest after 0.5 seconds,
- at the latest after 3 seconds during ventilation in adult mode and 1.5 seconds in pediatric mode, respectively.

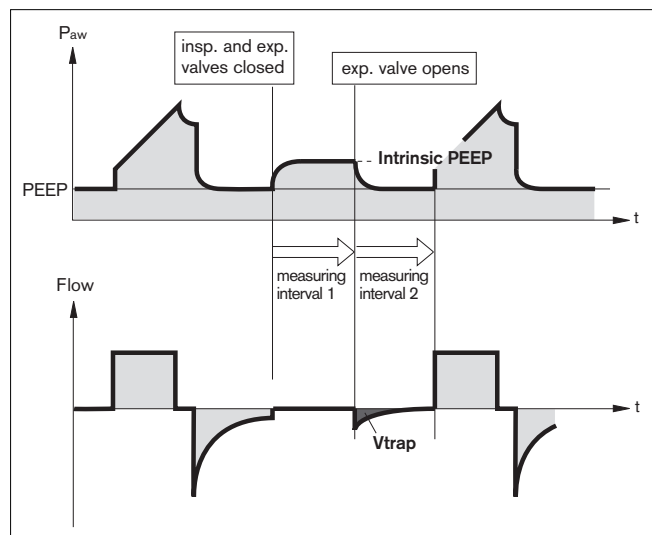
The start value corresponds to PEEP, and the value at the end of the closed phase is the intrinsic PEEP.

At the end of measuring interval 1, Evita 4 opens the expiratory valve and measures the expiratory flow generated by intrinsic PEEP during a defined measuring interval 2. During this period, lung pressure is allowed to decrease to PEEP level.

Measuring interval 2 is terminated:

- when expiratory flow has returned to 0,
- at the latest after 7 seconds during ventilation in adult mode and 3.5 seconds in pediatric mode, respectively.

The integrated flow corresponds to the gas volume trapped in the lungs ( $V_{\text{trap}}$ ) due to intrinsic PEEP.



Measuring intervals 1 for Intrinsic PEEP:

adult ventilation mode	max. 3 seconds
pediatric ventilation mode	max. 1.5 seconds

Measuring intervals 2 for  $V_{\text{trap}}$ :

adult ventilation mode	max. 7 seconds
pediatric ventilation mode	max. 3.5 seconds

## Inspiratory O<sub>2</sub> Concentration While Nebulizing Aerosols

The integrated nebulizer function of Evita 4 is designed for nebulizers with a nebulizing flow of 6 L/min at 29 psi (2 bar), for example nebulizer 84 12 935 (white central body). Other nebulizers may cause deviations in tidal volume and inspiratory O<sub>2</sub> concentration!

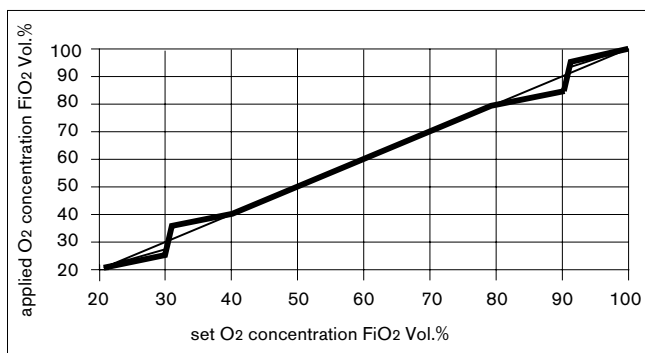
In order to minimize the deviation from the set O<sub>2</sub> concentration, Evita 4 uses blended gas to drive the nebulizer.

In adult patient mode this blended gas is produced by switching between the supply gases (medical grade air and oxygen) in synchrony with inspiration.

In pediatric patient mode, the nebulizer is driven continuously with air and oxygen alternating.

The driver gas of the nebulizer therefore roughly corresponds to the set FiO<sub>2</sub>.

The graph shows the possible deviations of the applied O<sub>2</sub> concentration for nebulizers with a nebulizing flow of 6 L/min at 29 psi (2 bar) as a function of the set FiO<sub>2</sub> at the lowest inspiratory flow (15 L/min) during adult ventilation or at breath rates greater than 12 bpm during pediatric ventilation, respectively.





## Abbreviations and Symbols

Abbreviation	Definition
APRV	<b>A</b> irway <b>P</b> ressure <b>R</b> elease <b>V</b> entilation Spontaneous breathing at continuous positive airway pressure with short-term pressure release
BIPAP (PCV <sup>+</sup> )	<b>B</b> iphasic <b>P</b> ositive <b>A</b> irway <b>P</b> ressure Ventilation mode for spontaneous breathing at continuous positive airway pressure with two different pressure levels
BIPAP <sub>Assist</sub> (PCV <sup>+</sup> <sub>Assist</sub> )	<b>B</b> iphasic <b>P</b> ositive <b>A</b> irway <b>P</b> ressure, <b>A</b> ssisted Ventilation mode for spontaneous breathing at continuous positive airway pressure with two different pressure levels
body Wt	Body weight (kg)
bpm	breaths per minute
BTPS	<b>B</b> ody <b>T</b> emperature, <b>P</b> ressure; <b>S</b> aturated Measured values based on the condition in the patient's lungs, with body temperature 37 °C, water vapor-saturated gas, atmospheric pressure
C	Compliance
CMV	<b>C</b> ontinuous <b>M</b> andatory <b>V</b> entilation Mandatory ventilation with positive pressure breaths
CMV Assist	Trigger assisted <b>C</b> ontinuous <b>M</b> andatory <b>V</b> entilation
CPAP	<b>C</b> ontinuous <b>P</b> ositive <b>A</b> irway <b>P</b> ressure Breathing with continuous positive pressure in the airways
etCO <sub>2</sub>	End-expiratory CO <sub>2</sub> concentration
f	Breath rate
fapnea	Rate setting for apnea ventilation
fmand	Mandatory mechanical portion of overall breath rate
fspn	Spontaneous breathing portion of overall breath rate
Fail to cycle	Breathing cycle failure. During CMV, Ventilator detects no inspiration within set apnea time
FeCO <sub>2</sub>	Expiratory CO <sub>2</sub> concentration
FiO <sub>2</sub>	Inspiratory O <sub>2</sub> concentration
Flow	Set value of the maximum inspiratory flow
FlowTrig	Set value of the flow trigger threshold
ILV	<b>I</b> ndependent <b>L</b> ung <b>V</b> entilation Ventilation with 2 ventilators, 1 for each lung
Int. PEEP	Intermittent Positive End-Expiratory Pressure = expiratory sigh
IRV	<b>I</b> nverse <b>R</b> atio <b>V</b> entilation Ventilation with inversed ratio of inspiration/expiration
ISO 5369	International standard for mechanical ventilators – "Lung Ventilation"
I:E	Ratio of Inspiration to Expiration
MMV	<b>M</b> andatory <b>M</b> inute <b>V</b> olume <b>V</b> entilation
MV	<b>M</b> inute <b>V</b> olume

Abreviation	Definition
MV <sub>spn</sub>	Spontaneously breathed minute volume
NIF	Negative Inspiratory Force Inspiratory effort
O <sub>2</sub>	Set value for inspiratory oxygen concentration [Vol. %]
P 0.1	Occlusion pressure at 100 ms
P <sub>supp.</sub>	Set value of pressure support
P <sub>aw</sub>	Airway pressure
PCV+ (BIPAP)	Pressure Controlled Ventilation plus Ventilation mode for spontaneous breathing at continuous positive airway pressure with two different pressure levels
PEEP	Positive End-Expiratory Pressure
PEEP <sub>i</sub>	Intrinsic Positive End-Expiratory Pressure
P <sub>high</sub>	Set value of the upper pressure level in APRV
P <sub>insp</sub>	Set value of the upper pressure level in PCV+ (BIPAP)
P <sub>low</sub>	Set value of the lower pressure level in APRV
P <sub>max</sub>	Set value for pressure limited ventilation
P <sub>mean</sub>	Mean airway pressure
PLV	Pressure Limited Ventilation
P <sub>peak</sub>	Peak pressure
P <sub>Plat</sub>	End-inspiratory airway pressure
R	Resistance
RSB	Rapid Shallow Breathing Quotient of spontaneous breathing rate and tidal volume
SIMV	Synchronized Intermittent Mandatory Ventilation
T	Inspiratory breathing gas temperature
T <sub>apnea</sub>	Alarm delay time for apnea
T <sub>e</sub>	Expiratory time
T <sub>high</sub>	Duration set for the upper pressure level in APRV
T <sub>insp</sub>	Set value of inspiratory time
T <sub>low</sub>	Duration set for the lower pressure level in APRV
V̇ CO <sub>2</sub>	CO <sub>2</sub> production [L/min]
V <sub>ds</sub>	Serial dead space
V <sub>ds</sub> /V <sub>T</sub>	Dead space ventilation
V <sub>T</sub>	Setting for tidal volume
V <sub>T</sub> Apnea	Setting for tidal volume of apnea ventilation
V <sub>T</sub> <sub>e</sub>	Expiratory tidal volume
V <sub>T</sub> <sub>i</sub>	Inspiratory tidal volume
V <sub>trap</sub>	Volume trapped in the lung by intrinsic PEEP, and exhaled during subsequent expiration.

**Abbreviations/  
Symbol****Definition**

Switch nebulizer on / off



Switch oxygenation program for bronchial suction on / off



Manual expiration



Manual inspiration



Manual printer logging



Switch help function on / off



"Freeze" waveforms on screen



Back to standard screen page



Silence audible alarm for 2 minutes



Reset alarms



Standby / Operation



Select other measured value combination



Select other waveform(s)



Rise time setting for pressure increase



Lower / upper alarm limit



Upper alarm limit



Refer to Operating Instructions!



Protection class I, Type B



Type BF



Insert flow sensor



Unlock expiratory valve



Adult patient mode



Pediatric patient mode



Spontaneous patient activity



Evita Remote (remote control pad)



Nurse call

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## At a Glance - These were New Features of Evita 4 Software 2.n

### P<sub>insp</sub> not linked to PEEP for PCV+ (BIPAP)

- The ventilation parameter P<sub>insp</sub> is set as an absolute value. A change of PEEP will not affect P<sub>insp</sub> any more.

### Loop display also for single breaths

- Besides displaying loops for a complete ventilation cycle, e.g. during CMV, a loop may also be displayed for a single breath (mechanical or spontaneous), e.g. for "mixed" ventilation modes, such as SIMV.

### User guides for pressure ventilation parameters

- During the setting of listed pressure parameters, the respective parameter appears as a dotted line in the P<sub>aw</sub> waveform display.

### NeoFlow (Option)

- Extends pediatric flow monitoring during ventilation of small children and infants by employing a special neonatal flow sensor at the wye.

### Continuous display of patient circuit compliance

- In the "Device check" menu, the test point "Pressure test of patient system" may be selected separately. The continuous display of leakage aids with corrective measures in case of a leaking circuit.

### Compensation of patient circuit compliance

- The compliance value determined during the pressure test of the patient circuit is displayed at the end of the test.
- Evita 4 uses this value of patient circuit compliance to automatically correct the volume controlled ventilator breaths as well as readings from flow monitoring.

### Leakage monitoring and compensation

- Evita 4 compares applied inspiratory minute volume with measured expiratory volume, calculates the leak, and displays the result as MV<sub>leak</sub>.
- The applied minute volume is automatically corrected with the measured MV<sub>leak</sub>, as well as flow monitoring values flow and VT<sub>e</sub>.
- For safety reasons, measured values of minute ventilation are not adjusted.

### Apnea ventilation with SIMV pattern

- The patient is enabled to breathe spontaneously during apnea ventilation.
- Apnea ventilation rate is kept constant.

### AutoFlow On/Off as a startup default parameter

- The function of AutoFlow may be configured as a startup default, so that AutoFlow is enabled when powering up the ventilator.

## **At a Glance - These Were New Features of Evita 4 Software 3.n**

### **Additional on-screen language settings**

- Portuguese
- Russian
- Arabic
- Greek
- Chinese

### **Additional front panel function key » /● «**

- For setting screen to dim or bright.

### **Independent Lung Ventilation ILV**

- Independent ventilation of the two lung compartments of a patient with two separate Evita ventilators.

### **Additional front panel function key »Exp. hold«**

- For manually extending an expiration.
- For occluding the patient circuit at the end of an expiration.

### **Nebulizing of medicated aerosols**

- Applicable also during pediatric ventilation.

### **Pre-/post-oxygenation for bronchial suction**

- In patient modes »Pediatric« or »Neonatal« Evita 4 increases the set O<sub>2</sub> concentration appropriately, but not to 100%.

### **Alarm message "Volume not constant"**

- may be suppressed.

### **Automatic Tube Compensation ATC (option)**

- For a reduction of work of breathing targeted at the WOB due to the patient tube.

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## Ordering Information

Name/Description	Order No.	Name/Description	Order No.
<b>Basic ventilator unit</b>			
Evita 4	84 11 900	Evita 4 DC	84 13 034
<b>Accessories required for operation</b>		ATC	84 14 556
Hinged circuit support arm	84 09 609	Mask Ventilation (NIV)	84 14 474
or		Upgrade kit Evita 4 sw 4.n plus	84 14 469
Quick-stop support arm 2	2M 85 706	(consists of sw upgrades: "weaning parameters", "external flow measurement", and "extended loop displays")	
Air supply filter and water trap, straight	84 14 453		
Air supply filter kit	84 14 703		
O <sub>2</sub> supply filter and water trap, straight	84 14 452	<b>For CO<sub>2</sub> measurement (option CapnoPlus)</b>	
O <sub>2</sub> supply filter kit	84 14 702	Test filter	68 70 281
<b>For mounting humidifier</b>		Calibration kit	84 12 710
Mounting brackets		Test gas cylinder CO <sub>2</sub>	82 90 271
(for Fisher Paykel MR 730)	84 11 074	CO <sub>2</sub> main flow sensor	68 70 300
<b>Special accessories</b>		Holder for "parking" CO <sub>2</sub> sensor	84 12 840
Instrument tray Evita 4	84 12 723	CO <sub>2</sub> -Cuvette, adult	68 70 279
Pneumatic aerosol nebulizer	84 12 935	CO <sub>2</sub> -Cuvette, pediatric	68 70 280
Adult test lung	84 03 201		
Mobile cart:		<b>Exchange parts for disinfection</b>	
"EvitaMobil" trolley (high)	84 14 455	Expiratory valve (patient block)	84 10 580
with column extension, 50 mm		For ventilating adults:	
Cabinet 8H, (14.2") high (4 drawers)	M 31 796	Patient circuit, adult (for use with	
Cabinet 4H (2 drawers)	M 31 795	Fisher & Paykel humidifier)	84 12 108
"EvitaMobil" cylinder holder set	84 11 970	Patient circuit, paed. (F&P)	84 12 081
Battery 12V/17A	18 43 303	Hose set HME	84 12 860
alternatively, to be installed		<b>Replacement parts</b>	
in mobile cart:		For Evita 4:	
Air compressor	84 13 890	O <sub>2</sub> sensor capsule	68 50 645
MEDIBUS cable	83 06 488	Flow sensor (set of 5)	84 03 735
Printer cable	83 06 489	Cooling-air filter, blue	84 12 384
ILV cable Evita 4/Evita 2 dura	84 11 794	For circuit support arm:	
VentView 1.n (incl. Medibus cable)	84 14 095	Circuit holder	84 09 746
Flowsensor Cover	84 14 714	Hose clamp	84 09 841
<b>Options/Kits for retrofitting on site</b>			
Evita 4 Link	84 11 735		
Evita 4 Sat	84 13 035		
Evita 4 CapnoPlus	84 13 780		
NeoFlow	84 13 563		
Nurse call	84 14 476		
Connector for nurse call	18 46 248		
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These Instructions for Use apply only to  
**Evita 4**  
with Serial No.:

If no Serial No. has been filled in by  
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are not intended for use with any specific  
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